UNIVERSITY
OF MICHIGAN

NOV 21 1950

ENGINEERING
LIBRARY

CLASSIFIED ADVERTISEMENT SUPPLEMENT

The Engineer

OCTOBER 20, 1950

28 ESSEX STREET, STRAND, LONDON, W.C.2.

PUBLIC NOTICES

SUDAN GOVERNMENT.

The Ministry of Agriculture requires a MECHANICAL ENGINEER - aged 28 to 35, for service in the Sudan. Candidates must possess thorough experience in the running, maintenance and repair of Diesel Engines. Candidates must have served a full apprenticeship or its equivalent in mechanical engineering with a manufacturer of Diesel Engines and have had subsequent experience of their installation and maintenance and that of allied machinery.

Appointment will be either on Long Term Contract on a salary scale £E.560 to £E.972 with special post-service gratuity; or on Short Term Contract, at higher rates of pay and different post-service benefits.

Cost of Living Allowance varying between £E.142 and £E.352 per annum according to the number of dependents is at present payable, and, subject to certain limitations, an Outfit Allowance of £E.40 is payable on appointment. There is at present NO INCOME TAX in the Sudan. Free passage on appointment. Full particulars and application form may be obtained on application to: Sudan Agent in London, Wellington House, Buckingham Gate, London, S.W.1. Please mark envelopes "Mechanical Engineer A.&.F." E5025

KENT COUNTY COUNCIL.

Applications are invited for the appointment in the Buildings Department of an ENGINEERING ASSISTANT (HEATING AND MECHANICAL) in A.P.T. Grade V (£520 - £570).

The post is superannuable and the successful candidate will be required to pass a medical examination.

Applicants must have passed the examinations required for Associate Membership of the Institution of Heating and Ventilating Engineers and have had at least five years' experience in the preparation of schemes, specifications and estimates for all classes of heating, hot and cold water supplies and ventilation work.

Applications, on forms obtainable from the County Architect, Springfield Maidstone, must be delivered to him not later than 14 days after the appearance of this advertisement.

W. L. PLATTS.
Clerk of the County Council.
County Hall, Maidstone.
3rd October, 1950 E5113

GORDON MEMORIAL COLLEGE, KHARTOUM, SUDAN.

Applications are invited for the newly created appointment of Professor of Civil Engineering.

Salary £E2093 plus cost of living allowance at present between £E142 and £333 according to number of dependents. Annual leave with free passages after first tour.

£E = £1.0.6d. No income tax at present payable in the Sudan.

Applications (six copies) giving the names of three referees should be sent to the Secretary, Inter-University Council for Higher Education in the Colonies, 1, Gordon Square, London, W.C.1., from whom further particulars may be obtained. Closing date 30th November, 1950. E5114

HIS MAJESTY'S COLONIAL SERVICE

A vacancy exists for an ELECTRICAL ENGINEER in the Public Works Department, Sierra Leone. Salary within the scale of £720 to £1,300 per annum, in addition a cost-of-living allowance of £60 to £125 per annum depending on salaries is payable. The post is pensionable and starting salary depending on age, qualifications, experience and war service but candidates should not be more than 40 years of age.

Candidates must be Corporate Members of the Institution of Electrical Engineers or hold equivalent qualification and should have served an electrical engineering apprenticeship and have a thorough knowledge of generation and distribution in an electricity supply undertaking and some mechanical experience in a Power Station is important. Must have sound experience in construction and maintenance of H.T. and L.T. distribution systems and in administration of an electricity undertaking. Experience in steam turbines and/or diesel engines an advantage.

The general qualifications and experience must be such as to enable the officer to act for the Chief Electrical Engineer when the latter proceeds on leave.

Furnished quarters at rents of £60 to £90 per annum and free first class passages each way each tour for the officer and his wife and family are provided. Home leave on full pay at the end of each tour of eighteen months at the rate of seven days for each month of resident service. Income tax at local rates.

Intending candidates should write for application form to the Director of Recruitment (Colonial Service), Sanctuary Buildings, Great Smith Street, S.W.1., giving brief particulars of age, qualifications and experience and quoting reference No. 27326/3. E5102

HIS MAJESTY'S COLONIAL SERVICE

A vacancy exists for an ELECTRICAL ENGINEER, Special Temporary Staff Public Works Department, Uganda Protectorate. The appointment is on contract/gratuity terms for a tour of 30 - 36 months at a salary between £655 and £1320 per annum depending on qualifications and experience. A gratuity at the rate of 15% of nine-tenths of total emoluments will be payable on satisfactory completion of a tour of service. The Contract is renewable, by mutual agreement with a possibility of being absorbed into the permanent and pensionable establishment.

Candidates must be an Associate member of the Institution of Electrical Engineers. Age 25 to 35 years. The officer will be responsible for the installation of electrical services in Government buildings and workshops etc. and carry out inspection of installations under the Electricity Ordinance.

If Government quarters are occupied a deduction of 10% of the salary or if at a hostel 5% of the salary is made for rent. Free 1st. Class passages for officer, his wife and children up to three adult fares in all. Free medical attention. Home leave after three years at the rate of five days for each month of residential service. Outfit allowance of £30 is payable on first appointment.

Intending candidates should apply for further particulars and application form to the Director of Recruitment, Sanctuary Buildings, Great Smith Street, S.W.1. giving brief details of age, qualifications and experience immediately, quoting reference No. 27326/28. E5101

HIS MAJESTY'S COLONIAL SERVICE. UGANDA.

A vacancy has occurred in the P.W.D. Uganda for an ASSISTANT ENGINEER (TEMPORARY STAFF). The duties will consist of road construction and maintenance and of building work, both by direct labour and contract. Appointment will be on contract/gratuity terms for one tour of 2½ to 3 years in the first instance. The contract will be renewable by mutual agreement. The salary is in the incremental scale of £655 to £1,320, point of entry being determined by war service and approved professional experience. Rent for partially furnished quarters is charged at the rate of 10% of salary. Up to the cost of 3 adult sea passages are granted for the officer, wife and children on appointment and on leave.

Candidates, between 35 and 45, should be A.M.I.C.E. or possess a degree in engineering. They should have had considerable general civil engineering experience.

For a form of application write, giving brief particulars of age, qualifications and experience, to the Director of Recruitment (Colonial Service), Colonial Office, Sanctuary Buildings, Great Smith Street, S.W.1. Please mention this paper and quote No. 27322/105. E5070

THE BRITISH ELECTRICITY AUTHORITY

(North Western Division) invite applications from suitably qualified candidates for the appointment of 2nd Assistant Engineer (Electrical) in the Generation (Construction) Department, which is situated at Agecroft Generating Station, Pendlebury, Near Manchester.

Candidates should have wide experience in design, layout and installation of the electrical plant associated with modern Generating Stations. Experience of Station operation and in a large manufacturer's works is desirable.

The salary for the post, which is superannuable, will be in accordance with Grade 2, Schedule C, of the Revised N.J.B. Agreement, i.e. £752 - £966 per annum.

Applications stating age, qualifications, and experience should be received by The Establishment Officer, British Electricity House, Wilmslow Road, East Didsbury, Manchester 20, not later than 14th October 1950. E5031

WOLVERHAMPTION CORPORATION WATER UNDERTAKING. ENGINEERING ASSISTANT.

Applications are invited for the appointment of an Engineering Assistant on the permanent staff, determinable by one month's notice on either side, subject to the provisions of the Local Authorities National Scheme of Conditions of Service, the Local Government Superannuation Act, 1937, and to a medical examination. The salary will be in accordance with the A.P.T. Grade V (£520 - £570 p.a.) Applicants should be corporate members of the Institution of Civil Engineers and have waterworks experience. Applications stating age, qualifications, experience, present and past appointments, and accompanied by copies of two recent testimonials, should be received by the undersigned not later than Monday the 30th October, 1950. J. BROCK ALLON, Town Clerk, Town Hall, Wolverhampton. E 5085

GOVERNMENT OF IRAQ

FIRST ASSISTANT PORT ENGINEER required by Basrah Port Directorate for three years in first instance. Salary I.D. 110 per month plus Cost of Living Allowance up to I.D. 14 a month. (Iraq Dinar 1 equals £1). Free passages. Provident Fund. Candidates must be A.M.I.C.E. or hold degree granting exemption from Section A and B of the Institute's examination and should have had all round experience, preferably combining some knowledge of port and river work and Municipal Engineering and town planning. Apply at once by letter, stating age, full names in block letters, and full particulars of qualifications and experience and mentioning this paper to the Crown Agents, 4, Millbank, London, S.W.1. quoting M/N/13796(3A) on both letter and envelope. The Crown Agents cannot undertake to acknowledge all applications and will communicate only with applicants selected for further consideration. E 5100

HIS MAJESTY'S COLONIAL SERVICE

Vacancies exist for MECHANICAL ENGINEERS in the Public Works Department, Nigeria. The posts are on contract for one tour in the first instance on a fixed salary between £830 and £1,450 depending on age, qualifications and experience. In addition a temporary cost-of-living allowance of £60 to £110 per annum is payable. Candidates should be qualified Mechanical Engineers and have had practical experience in workshops dealing with the maintenance of engineering construction plant or pumping plant for water supplies. Partly furnished quarters are provided at a rental of £60 to £150 per annum, depending on salary. Free passages are provided for the officer and his wife and 2 children on first appointment and on leave. Income Tax is at local rates, which are much lower than those in the United Kingdom. Leave on full salary is granted after normal tours of 18 months at the rate of 7 days for each completed month of residential service. Free medical attention. Candidates should write at once for a form of application and further particulars to the Director of Recruitment (Colonial Service), Colonial Office, Sanctuary Buildings, Great Smith Street, S.W.1., quoting reference No.27325/6. E 5071

BRITISH ELECTRICITY AUTHORITY

SENIOR ASSISTANT
CONTRACTS DEPARTMENT

BRITISH ELECTRICITY AUTHORITY - Applications are invited for the post of a Senior Assistant in the Contracts Department at the Authority's Headquarters in London to act as Chief Clerk. The commencing salary for the appointment, which is superannuable, will be in accordance with Grade 9 of the National Joint Council Agreement £940 per annum x £40 to £1,060 per annum including London Allowence. Candidates should be fully qualified to deal with all stages of the procedure involved in the placing of major contracts for generation and transmission plant and equipment, particularly in respect of Terms and Conditions of contract, price variation clauses and similar matters but excluding the consideration of matters relating to price. The successful applicant will be in control of a General Office and will be expected to handle a large volume of documents with accuracy and expedition. Applicants will be expected to have extensive commercial experience, preferably of the class of contracts placed by the Authority and of the manufacturing industries which supply the Authority, and should have had experience in the control of a General Office responsible for the receipt, recording, examination, filing etc., associated with the placing of a large volume of contracts, together with the preparation of returns and schedules and the keeping of various records. Letters of application, giving age, present position and full details of qualifications and experience, should be forwarded to D.MOFFAT, Director of Establishments, British Electricity House, Great Portland St., London, W.1., to be received not later than 30th. October 1950. Please quote reference AE:110. E 5119

BRITISH ELECTRICITY AUTHORITY

LONDON DIVISION
DIVISIONAL HEADQUARTERS

DRAUGHTSMEN-Applications are invited from men with experience in one or more of the following branches in connection with the construction of Power Stations in the London Area:-

ELECTRICAL ENGINEERING (a) General design, assembly and layouts of H.T. and auxiliary switchgear, transformers, cables and heavy plant. (b) Able to originate and check the associated diagrams and protective systems of the above plant both for Power Stations and Substations.

MECHANICAL ENGINEERING. General design, assembly and layouts of modern Boiler and Fuel, handling plant, Turbo-Alternators and Condensing Plant, circulating water systems, steam, feed, and auxiliary piping, foundations, etc. The salary offered, which is provisional and subject to negotiation with the appropriate organisation, will be according to age and experience with a maximum of £600, per annum. Applications stating age, qualifications and experience, should be addressed to the Divisional Secretary, British Electricity Authority, London Division, Ergon House, Horseferry Road, Westminster, S.W.1., and be received within 14 days of the publication of this advertisement. E 5030

CROWN AGENTS FOR THE COLONIES

LEADING DRAUGHTSMAN required for the London Office. Salary £500 a year rising by annual increments of £20 to £620 a year, and thence by one annual increment of £5 to £625 a year. Engagement will be on unestablished terms terminable by one month's notice from either side, with the prospect after satisfactory service, of appointment to the established and pensionable staff, vacancies permitting. The normal working week is 45½ hours and extra duty allowance is paid for hours worked in excess of 42. Duties entail the preparation of drawings for steel and re-inforced concrete structures including bridges, buildings, and general Civil Engineering design work. Candidates should have had experience as a Draughtsman in the office of a Civil Engineer, the Civil Engineering Department of a Railway, or a firm of Structural Engineers. They should have had considerable experience in preparing designs for bridges and buildings in steel and must be good draughtsmen. A knowledge of re-inforced concrete design would be an advantage. Apply at once by letter, stating age, full names in block letters and full particulars of qualifications and experience, and mentioning this paper to the Crown Agents for the Colonies, 4, Millbank, London, S.W.1. quoting M/N/26607/3A. on both letter and envelope. The Crown Agents cannot undertake to acknowledge all applications and will communicate only with applicants selected for further consideration. E 5193

LONDON COUNTY COUNCIL

MATERIALS ASSISTANTS required by the Government of Kenya for the Public Works Department for one tour of 4 years. Salary according to qualifications and experience in scale £550 to £690 a year. Free passages and liberal leave on full salary. Gratuity payable on satisfactory completion of engagement. Opportunities exist for promotion to contract or pensionable posts. Candidates, not over 40 years of age, should have Higher School Certificate, Higher National Certificate in Building or equivalent qualification and experience in Civil Engineering Works or in a laboratory. Ability to take charge of men an advantage. Apply at once by letter, stating age, full names in block letters, and full particulars of qualifications and experience, and mentioning this paper to the Crown Agents for the Colonies, 4, Millbank, London, S.W.1. quoting M/N/23296/3E. on both letter and envelope. The Crown Agents cannot undertake to acknowledge all applications and will communicate only with applicants selected for further consideration. E 5192

CROWN AGENTS FOR THE COLONIES

South East London Technical College, Lewisham Way, S.E.4. Required as soon as possible LECTURER qualified to take Part-time Day and Evening Higher National Certificate and C.G.L.I. classes in Utilisation of Electrical Energy and Installation Work. Salary in accordance with the Burnham (London) scale. Application form, obtainable from the Secretary of the College on receipt of stamped addressed foolscap envelope, returnable by 4th November, (1331) E 5195

WEAR AND TEES RIVER BOARD

APPOINTMENT OF CHIEF ENGINEER

Applications are invited for the above appointment on the staff of this Board which has recently been constituted under the River Boards Act, 1948. The Chief Engineer will be responsible for the control and execution of land drainage and other engineering works for the Board. Applicants should be Corporate Members of the Institution of Civil Engineers, or hold equivalent qualifications and should have considerable experience of land drainage work. Salary £1,000 p.a. to £1,250 by annual increments of £50, subject to satisfactory service. The appointment is subject to the Local Government Superannuation Act, 1937, and to medical examination. Applications stating (a) age, qualifications, experience and particulars of present employment; (b) when the applicant would be free to take up duty; (c) whether the applicant is related to any member of the Board and (d) the names and addresses of three referees, should reach the undersigned not later than Wednesday, the 11th November, 1950. Canvassing in any form will disqualify. A.G. Stirk, Clerk of the Board. (Temporary Offices)Clark's Yard, High Row, DARLINGTON,Co.Durham.

E 5128

ALFORD DRAINAGE BOARD ENGINEER

APPLICATIONS are invited for appointment to the Board as qualified Civil Engineer. Experience in land drainage maintenance and improvement works, including the design, construction and control of pumping plants and on sea defence works, including heavy piling and designing of re-inforced concrete desirable. Salary between £700 and £900 according to experience, the successful candidate providing a car and receiving travelling expenses on the Board's scale. The Local Government Superannuation Act, 1937,will apply. Applications, stating name,age, qualifications and experience,together with the names of three referees, must be received by the undersigned not later than the 27th October, 1950 J.R.TINN, Clerk to the Board, 6,High Street, ALFORD, Lincolnshire. E 5159

BRITISH ELECTRICITY AUTHORITY

SENIOR ASSISTANT, CONTRACTS DEPT.

BRITISH ELECTRICITY AUTHORITY - Applications are invited for the post of Senior Assistant in the Contracts Department at the Authority's Headquarters in London, to deal primarily with mechanical engineering contracts. The salary for this appointment,which is superannuable, will be within the range £800 - £1,100 according to qualifications and experience. This range is provisional and subject to negotiation within the appropriate negotiating machinery. Candidates should be fully qualified to deal with all stages of the procedure involved in the placing of major contracts for mechanicalengineering plant and equipment, including the critical assessment of tenders and the preparation of contract documents. Applicants will be expected to have had extensive commerical experience of the class of contracts placed by the Authority and of the manufacturing industries which supply the Authority, and should possess sufficient technical background to enable them to appreciate the commercial significance of the technical aspects of the specifications and tenders with which the Department is concerned.Negotiating experience in the placing of contracts of substantial magnitude is an essential qualification. Letters of application, giving age, present position and full details of qualifications and experience, should be forwarded to Mr. D. MOFFAT, Director of Establishments, British Electricity House, Great Portland Street, London, W.1., to be received not later than 30th October, 1950. Please quote reference AE:109. E 5120

HIS MAJESTY'S COLONIAL SERVICE.

TRINIDAD

The Works and Hydraulics Department require a SANITATION ENGINEER. The duties are, primarily, the design and organisation of engineering measures for the improvement of sanitation, especially for the abatement of malaria, including river clearing, swamp drainage, main urban and rural drainage. Ultimately the duties may include the execution of all drainage, irrigation and reclamation work.Appointment will be on probation for permanent and pensionable employment in the salary scale $3,600 to $5,760 (£750 to £1,200 per annum. War service and professional experience will determine point of entry into this scale.Quarters are not provided but a house allowance is payable. Other conditions include: free passages on appointment and on leave; leave on full pay at the rate of 45 days per year's service after each tour of 3 years. Candidates should be Corporate Members of the Institution of Civil Engineers or possess a degree or diploma which exempts from Sections "A" and "B" of the A.M.I.C.E. examinations. They must have had at least two year's practical experience in engineering works, preferably including experience in the design and construction of drainage and irrigation schemes. For a form of application write, giving brief particulars of age, qualifications and experience to the Director of Recruitment (Colonial Service), Sanctuary Buildings, Great Smith Street, S.W.1. Please mention this paper and quote No. 27322/130. E 5146

BOROUGH OF MANSFIELD

WATER DEPARTMENT

APPOINTMENT OF CHIEF TECHNICAL ASSISTANT. Applications are invited for the appointment of Chief Technical Assistant in the Water Department at a salary in accordance with Grade 5A/6 (£550 - £660 per annum) of the National Joint Council's Scale of Salaries. HOUSING ACCOMMODATION WILL BE MADE AVAILABLE BY THE COUNCIL IF REQUIRED. Applications endorsed "Chief Technical Assistant" stating age, qualifications, education, experience and previous appointments together with names and addresses of at least two persons to whom reference can be made should be sent to the undersigned not later than the 31st. October, 1950. A.C.SHEPHERD, Town Clerk, Carr Bank, Mansfield.

E 5123

LONDON ELECTRICITY BOARD

STRUCTURAL DRAUGHTSMEN. Applications are invited for the above positions in the Chief Engineer's Department at present located at Lesco House, Stamford St.,S.E.1. Applicants should be designer-detailers having a knowledge of building construction and experience in the design and detailing of either reinforced concrete or structural steelwork, or both. Pending grading of the posts under the National agreement of the appropriate negotiating body, commencing salaries will be from £500 per annum, dependent upon qualifications and experience. Application forms obtainable on receipt of an addressed foolscap envelope, from Establishments Officer 46, New Broad St.,E.C.2., to be returned not later than 21st.October, 1950.,quoting ref. EST/V/905/EE on envelope and all correspondence.

E 5130

HIS MAJESTY'S COLONIAL SERVICE

LEEWARD ISLANDS

A WATER ENGINEER is required for service in the Public Works Department of St. Kitts-Nevis.He will be required to assume administrative charge of all water supplies in the Presidency and be responsible for completing an approved programme of small water supply schemes. The post is, at present, non-pensionable and appointment will be for three years, in the first instance, at a salary of from £800 to £1,100 per annum according to qualifications and experience. Quarters are not provided. Free passages, not exceeding the total cost of three adult passages, will be provided for the officer and his family on appointment and on the satisfactory termination of the contract. Leave will be granted at the rate of one week for each three months' resident service. Candidates should be corporate members of the Institution of Civil Engineers and they must have had experience in the design, construction and maintenance of the various branches of modern public water supplies. Experience in the operation and maintenance of pumping machinery, including bore-hole pumps, is essential. For a form of application write, giving particulars of age, qualifications and experience, to the Director of Recruitment, (Colonial Service),Colonial Office, Sanctuary Buildings, Great Smith Street,S.W.1. Please mention this paper and quote No. 27329/37/50. E 5145

UNIVERSITY OF BIRMINGHAM.

Applications are invited for the post of Lecturer (Grade 1) in Civil Engineering at a salary within the range £1,150-£1,400, duties to commence 1st January, 1951 or as soon as possible thereafter.

The successful applicant should have special knowledge of reinforced concrete and general structural design.

Further particulars may be obtained from the undersigned, to whom applications, accompanied by the names of three referees, should be forwarded by 1st November, 1950.

C. G. BURTON,
Secretary.

The University,
Birmingham, 3.
October, 1950.

E5094

LONDON TRANSPORT EXECUTIVE.

Applications are invited for a post of GENERAL TECHNICAL ASSISTANT in the Technical Investigation Office.

The successful candidate will be required to assist in investigations, preparation of reports on special technical materials, equipments and methods, and the analysis and collation of technical information from outside sources.

The work relates to the Permanent Way, Buildings and Structures, Signal and Electrical divisions of the Department of the Chief Engineer.

Previous experience is not necessary but possession of a degree in science or engineering, or equivalent professional qualification, is essential.

Commencing salary will be according to age and experience up to £420 per annum with additional payments for certain recognized qualifications.

The appointment is subject to a medical examination. Upon completion of a satisfactory probationary period the selected applicant will be expected to join a contributory superannuation scheme. Canvassing, either directly or indirectly, will disqualify.

Applications giving full details of age, training, experience and present salary should be sent within fourteen days of the appearance of this advertisement to the Staff Officer (F/EV 148), London Transport Executive, 55 Broadway, London, S.W.1. For acknowledgment enclose addressed envelope. E5052

GORDON MEMORIAL COLLEGE, KHARTOUM, SUDAN.

Applications are invited for the post of ASSISTANT LECTURER OR LECTURER IN MECHANICAL ENGINEERING.

Salary scale for Assistant Lecturers £E771 rising to £E860 after two years; for Lecturers £E949 rising by biennial increases to £E1644. Point of entry determined by age, qualifications and experience. Cost of Living Allowance at present between £E142 and E358 according to number of dependents. Appointment on up to seven year contract with bonus on completion of one month's salary for each year of service. Annual leave with free passages after first tour.

£E = £1.0.6d. No income tax at present payable in the Sudan.

Applications (six copies) giving the names of three referees, should be sent to the Secretary, Inter-University Council for Higher Education in the Colonies, 1, Gordon Square, London, W.C.1, from whom further information may be obtained. Closing date 30th November, 1950. E5115

THE ADMIRALTY

invite applications for a limited number of temporary appointments in the SENIOR EXPERIMENTAL OFFICER and EXPERIMENTAL OFFICER GRADES for employment at Admiralty Experimental Establishments situated in various parts of Great Britain. Candidates should be either (i) Mechanical Engineers (C.267/50) who have had research and development experience in light mechanisms, or (ii) Electrical Engineers (D.152/50) or Physicists (A146/50) with research and development experience in light electrical mechanisms, electronics or acoustics. They should possess one of the undermentioned qualifications:

(a) a University degree in Science Engineering or Mathematics,

(b) graduate membership of an appropriate professional institution,

(c) Higher National Certificate,

(d) the final certificate of a five year grouped course in a relevant subject at the City and Guilds of London Institute, or any comparable Institution.

(e) Higher School Certificate with Mathematics or Science as a principal subject, or an equivalent qualification.

Candidates must be British subjects. For Senior Experimental Officer posts, they must be at least 35 years of age, and for Experimental Officer at least 26.

The London salary scales for men are:- Senior Experimental Officer £755 - £935 p.a. and Experimental Officer £525 - £675 p.a. For service outside London, these rates are subject to the standard provincial differentiation; the salary scales for women are somewhat lower. Exceptionally, starting salaries above the respective minima may be granted according to qualifications and experience.

Forms of application may be obtained from the Secretary, Ministry of Labour and National Service, Technical and Scientific Register, York House, Kingsway, London, W.C.2. quoting appropriate reference No.(K) Closing date 13th November 1950. H.Q.1138-50 9/50 D.C. E5152

AUCKLAND UNIVERSITY COLLEGE
New Zealand

Applications are invited for a LECTURER IN MECHANICAL ENGINEERING. Applicants should be qualified Mechanical Engineers with a University degree or its equivalent, preferably with Honours. Salary scale is £NZ660 per annum rising to £NZ760 per annum by two increments of £50. Allowance is made for travelling expenses and it is understood that accommodation is available. Further particulars and information as to the method of application are obtainable from The Secretary, Association of Universities of the British Commonwealth, 5 Gordon Square, London, W.C.1. The closing date for the receipt of applications is 15th November, 1950. E 5029

London County Council
CHIEF ENGINEER'S DEPARTMENT

Assistant Resident Engineers required on the construction of Sedimentation Tanks at Northern Outfall Works, Beckton, E.6. The work will entail the construction of large tanks, channels and culverts in reinforced concrete on piled foundations, pipelines, roads, etc. Applicants should have had experience in setting out and supervising such work. The vacancies are for assistants with salaries (a) up to £700 and (b) up to £580 a year. Application forms obtainable by sending stamped addressed foolscap envelope to the Chief Engineer, The County Hall, Westminster Bridge, S.E.1. (Quoting Vacancy No. 50/38), returnable in fourteen days after the appearance of this advertisement. Canvassing disqualifies. (1296) E 5099

INSTITUTE OF MARINE ENGINEERS.

The SECRETARYSHIP of the Institute will become vacant in October 1951. The Council invite applications for this appointment from suitably qualified candidates who will be between 30 and 45 years of age at the above mentioned date. Applications, giving full particulars of qualifications, experience, and salary required should be sent to the Secretary, Institute of Marine Engineers, 85, Minories, London, E.C.3. not later than the 31st December, 1950. E5111

GOVERNMENT OF IRAQ.

MECHANICAL AND ELECTRICAL ENGINEER required by the Directorate General of Municipalities, Iraq, for a tour of 2 years in first instance. Salary of not less than I.D.150 a month plus cost of living allowance of between I.D.10 and I.D.14 a month according to dependants. (I.D.1. = £1). The post is non-pensionable but there is a Provident Fund. Free passages. Candidates must be Corporate Members of the Institution of Mechanical Engineers and the Institution of Electrical Engineers, or possess one of these qualifications and have a sound technical knowledge and suitable experience in both electrical and mechanical engineering. They must be capable of undertaking the design of A.C. and D.C. public lighting systems and be fully acquainted with the installation, maintenance and operation of diesel electric generating plants and electrically driven pumping units, and the layout and construction of H.T. and L.T. overhead lines. Apply at once by letter, stating age, full names in block letters, and full particulars of qualifications and experience, and mentioning this paper to the Crown Agents, 4, Millbank, London, S.W.1. quoting M/N/24694(3B) on both letter and envelope. The Crown Agents cannot undertake to acknowledge all applications and will communicate only with applicants selected for further consideration. E5041

CROWN AGENTS FOR THE COLONIES

ENGINEERING ASSISTANT required by the Government of Northern Rhodesia for one tour of 36 months in the first instance. Commencing salary according to age and experience in the scale £510 rising to £865 a year plus cost of living allowance up to £39 a year. Outfit allowance £30. Free passages. Gratuity on satisfactory completion of service. Liberal leave on full salary. Candidates not over 40 years of age, should have had general civil engineering experience in a drawing office and in the field and be able to make open and closed traverses, contour plans and similar elementary surveys. Apply at once by letter, stating age, full names in block letters, and full particulars of qualifications and experience and mentioning this paper to the Crown Agents for the Colonies, 4, Millbank, London, S.W.1. quoting M/N/24886/3A on both letter and envelope. The Crown Agents cannot undertake to acknowledge all applications and will communicate only with applicants selected for further consideration. E 5194

BRITISH ELECTRICITY AUTHORITY

erseyside and North Wales Division
Applications are invited for the
ppointment of JUNIOR ENGINEER in the
ydro-Electric Engineering Department
the North Wales Group Office,
andudno Junction, North Wales.
alary will be £375/£505 per annum,
eing class AX, Grade 9, of the
ational Joint Board Agreement.
pplicants should have had a recog-
ised training in civil engineering
nd have general experience of sur-
eying and civil engineering work.
reference will be given to candid-
tes holding a University Degree in
ivil Engineering, or Associate Mem-
ership of the Institute of Civil
ngineers. The appointment will be
superannuable under the British
lectricity Authority and Area Boards'
uperannuation Scheme, and subject to
medical examination. Forms of app-
ication may be obtained from the
ivisional Secretary, British Elect-
icity Authority, Merseyside and
orth Wales Division, Clarke Gardens,
olton, Liverpool, and should be
eturned to him not later than Wed-
esday, 25th October, 1950. E 5118

BERWICK CORPORATION
WATER WORKS DEPARTMENT

Offers are invited for the under-
entioned REDUNDANT MACHINERY due to
lectrification:-

1 Lancashire Boiler 7' x 26'.
low off Press. 120 lbs. per sq.in.
akers - Arnott, Coatbridge.

1 Cross Compound condensing engine
13½" x 25" x 24" direct coupled to
treble ram single acting pump.
utput - 40,000 galls. per hr. at
45 revs. per min. against 300 ft.head.
akers - Messrs. Tangye, Birmingham.

1 Air Compressor 12" x 10" x 8".
apacity 100 cubic ft. free air per
in. revs. 150.
akers - Frank Pearn & Co.,Manchesten

1 Air receiver 5'8" x 2" x 5/16th"
The plant can be inspected any
time by arrangement with the Borough
Engineer, Tel. Berwick 6332, and
offers should be sent to the under-
signed on or before Monday, 6th
NOVEMBER, 1950, in a plain sealed
envelope endorsed "OFFER FOR STEAM
PLANT".

R. B. DAVISON,
Town Clerk.

unicipal Buildings,
erwick-upon-Tweed. E5177

WHISTON RURAL DISTRICT COUNCIL,
PRESCOT, LANCASHIRE.

Tenders are invited for the supply of Valves, Machinery and Equipment for use in the new SEWAGE DISPOSAL WORKS to be constructed at RAINHILL.

The Contract will be divided into the following sections:-

Section A - Valves and Penstocks.
Section B - Power operated Mechanically Raked Screens, Conveyor Belt and Hand Raked Screen.
Section C - Rotary Sprinklers.
Section D - Pumping Equipment.

Contractors may tender for any or all of these sections.

Conditions of Contract, Specifications and Bills of Quantities, can be obtained on request from the offices of the Consulting Engineers, MESSRS. HUSBAND & CO., at 388 GLOSSOP ROAD, SHEFFIELD 10. All enquiries should state the sections for which it is proposed to tender.

Sealed tenders must be delivered to the undersigned not later than noon on NOVEMBER 8th, 1950.

The Council does not bind itself to accept the lowest or any tender.

Dated this 11th day of October, 1950.

J. R. HENLEY.
Clerk of the Rural District Council.
Council Offices,
Whiston,
Prescot, Lancs. E5183

SOUTH EASTERN GAS BOARD.

Gas Engineering Draughtsmen (East Surrey and West Surrey Divisions (Croydon and Wandsworth) Reference V14/87.

Applicants must have had drawing office experience with a Gas Undertaking or Gas Works Plant Contractors and must be fully competent to prepare drawings, specifications and estimates for the design and layout of Gas Works and Gas Distribution Plant, mains and buildings.

Commencing salaries, according to experience and qualifications, will be within the range £480/650 per annum.

Draughtsman, Ordnance Wharf (Tar Works) Greenwich,S.E.10. Reference V14/102.

Applicants must be fully competent to prepare drawings, specifications and estimates of plant used in Chemical Engineering Work. Experience is required in the design of industrial plant, layout of works, power transmission, design of simple structures and the preparation of simple building and drainage schemes. Some shop experience would be preferable.

Commencing salary will be from £480 per annum according to experience and qualifications.

Junior Draughtsman, Physical Laboratories, Old Kent Road,S.E. Reference V14/99.

An Engineering Workshop trainee is required, preferably with a knowledge of furnace construction, mechanicalhandling practice and the design of gas appliances.

Commencing salary will be within the range £280/450 per annum according to experience and qualifications.

Junior Draughtsmen, Distributing Engineers' Offices, East Surrey and West Surrey Divisions (Croydon and Wandsworth) Reference V14/82.

It will be of advantage to applicants if they have had experience in the preparation of maps and plans and a knowledge of Engineering Draughtsmanship.

Commencing salary will be within the range £280/450 per annum according to experience and qualifications.

Applications in writing, quoting appropriate reference, should contain details covering present occupation, age, qualifications and experience, etc., and should reach the undersigned not later than fourteen (14) days after publication of this notice.

R. J. McCRAE
Personnel Manager.
Katharine Street
Croydon. E5103

SITUATIONS OPEN

A LARGE engineering works near London requires One or Two SENIOR PRODUCTION ENGINEERS capable of taking executive responsibility after a period of initiation. Candidates should be in the region of 30-35 years of age, have either an engineering degree or corporate membership of an engineering institution, and detailed experience of large scale production of small electrical/mechanical mechanisms, including production control and costing. Kindly state fullest details including age and salary required. Address, E5093, The Engineer Office. A.

A LIGHT Engineering Company in South Wales requires a CHIEF DRAUGHTSMAN. Applicants should be men between 30-45 years of age, possessing a complete knowledge of Press and Jig and Fixture Design. Salary approx. £650, according to age and qualifications. Housing accommodation will be made available. Address, E5175, The Engineer Office. A.

A LIGHT Engineering Company in South Wales requires a DEVELOPMENT ENGINEER. Applicants should be men between 25-45 years of age and possess a good all round knowledge of Engineering Process Layout, Tool Design and Mechanical Handling. Salary approx. £600, according to age and qualifications. Housing accommodation made available. Address, E5176, The Engineer Office. A.

A LIGHT Engineering Company in South Wales requires a TOOL DESIGN CHECKER. Applicants should be men between 30-45 years of age and possess a complete knowledge of Press Tool and Jig and Fixture Designs. Salary approx. £600, according to age and qualifications. Housing accommodation made available. Address, E5177, The Engineer Office. A.

A LARGE Manufacturing Organisation with factories throughout Britain require at their head office, London, a SENIOR PLANNING ENGINEER. Applicants should be 30-40 years of age and have a good University Degree and/or Corporate Membership of the Institute of Mechanical or Chemical Engineers. Should have some practical works experience and have held responsible positions dealing with Design, development, planning and installation of chemical plants. This post would necessitate some travelling throughout the country and offers excellent opportunities with an attractive salary. Apply giving full details of age, qualifications and experience to Dept. M.73. Box 4125E. A.K.Advtg., 212a, Shaftesbury Avenue, W.C.2. E.5112 A.

A TRAINING IN DRAUGHTSMANSHIP can now be given to several young men aged 20-23 who have had at least three years workshop experience and who have obtained Ordinary or Higher National Certificates in Mechanical Engineering. These vacancies exist at the Rugby Works of English Electric Company, and preference will be given to applicants who have some experience of steam, gas or water turbines, or diesel engines. Apply giving full particulars quoting ref. 152 to Central Personnel Services, English Electric Co.Ltd., 24-30, Gillingham Street, London, S.W.1. E5065 A.

A POSITION of permanency with pension rights on the Switchgear Drawing Office staff of the English Electric Company at Stafford is now available to SENIOR DRAUGHTSMEN with experience of station layout for Outdoor Switching Stations. Experienced layout draughtsmen are asked to send particulars of their experience quoting ref. 151 to Central Personnel Services English Electric Co. Ltd., 24-30, Gillingham Street, London, S.W.1. E5064 A.

A RESPONSIBLE position with prospects of advancement in Engineer's office in Bradford is available for a man experienced in dealing with shipments, correspondence relating to orders, and the control of staff. Mechanical aptitude an advantage. Write giving details of experience and salary asked. Address, E3523, The Engineer Office. A.

A RESPONSIBLE and experienced ENGINEER aged 40 to 45 years required for Yorkshire factory. Appointment carries excellent prospects for candidate with A.M.I.Mech.E. or its equivalent. Knowledge of high temperature automatic production units an advantage. Reply stating full details of practical experience and technical qualifications together with salary required. Address, E3559, The Engineer Office. A.

A TECHNICAL REPRESENTATIVE is required by a well-known organisation distributing heavy earth moving equipment and civil engineering plant. Mechanical or civil engineering background an advantage but training will be given. Applications, with full particulars, should be addressed to Box No E5083, The Engineer Office. A.

A VACANCY exists in the Research Department of Vickers-Armstrongs Ltd., Barrow-in-Furness, for a young graduate in Physics or Engineering with experience of industrial instruments with particular reference to the design, maintenance and operation of Electronic Instruments. Particulars should be addressed to the Senior Personnell Officer, stating qualifications, age, experience and salary required. E5057. A.

ADMINISTRATIVE opportunity - ENGINEER 26-30, experience in light engineering required to undertake training leading to responsible Costing position in East Anglian factory. Write, E3537, The Engineer Office. A.

ADVERTISERS wish to appoint an engineer of outstanding technical ability as DEPARTMENTAL MANAGER, with University standard or equivalent degree, and with sound commercial and practical training in administration of a large engineering office. A thorough knowledge of steam boiler design as applied particularly to Power Station construction is essential. The position is important and carries a corresponding remuneration, with scope for advancement. Applications, which will be treated in the strictest confidence, should give full particulars of education, experience and qualifications, and should in the first place be addressed to Box No. E5144, The Engineer Office. A.

AN ELECTRICAL ENGINEER of Degree standard, age 25-30 with some mechanical experience required to take charge of a subsection of the Design Proving Laboratory at our Birmingham Works. This engineer will be responsible for all laboratory testing of Automobile Electrical Equipment on completion of development and before quantity production. A staff of two or three engineering assistants will be available to help carry out performance, endurance, climatic, vibration and other special tests. The applicant should have the ability to think analytically and, preferably, have had some administrative experience. Salary will be in the range £450-£600 but the commencing salary may be above the minimum. Apply, in writing, giving full details of education, qualifications, past experience, age and other relevant information to the Personnel Manager, Joseph Lucas Limited, Birmingham, 19. E3509 A.

AN ENGINEERING works in the Midlands has opening for ASSISTANT to the CHIEF ENGINEER to be primarily engaged on Design Research connected with heavy duty vehicles and their transmissions. Candidates should have had recent experience in this field and be capable of developing ideas in line with modern competitive manufacture. Apply with all particulars. Address, E5074, The Engineer Office. A.

AN ESTIMATING ENGINEER of considerable experience and ability is required by a leading firm of chemical engineers to take charge of their estimating department. Applicants should be fully trained and qualified engineers with a wide knowledge of the construction, manufacture and cost of large scale chemical, process and petroleum plants and equipment and conversant with modern estimating methods. Age 40-50. London Area. Address, E5050, The Engineer Office. A.

AN INDUSTRIAL firm of standing requires a man of ability and energy for its Production Department where he will be in close touch with the Directors. Candidates should be between 30 and 35 years of age, possess a University degree in Engineering or Science and have experience of executive responsibility in a Production Department. The post carries a four figure commencing salary with the opportunity of rising to £3,000 a year in five or six years, and is pensionable. Full details of qualifications and experience should be sent to Box No. E5026, The Engineer Office. A.

ANGLO-IRANIAN Oil Company requires FUEL TECHNOLOGIST for work at London Head Office, with occasional visits abroad. Applicants, under 40 years of age, should be in possession of an Engineering Degree or Associate membership of Mechanical or Heating and Ventilating or Fuel/Petroleum Institutes, and have had practical experience of (a) Coal to Oil Furnaces or (b) the Design of Industrial Heating Plant or (c) Industrial Research or (d) as Fuel Engineer. Salary according to age, qualifications and experience. Write, quoting Department M. 1383 to Box 5974 at 191, Gresham House, E.C.2. E5066 A.

ANGLO-IRANIAN Oil Company require one MATHEMATICIAN, one MATHEMATICAL PHYSICIST and one PHYSICIST with some mathematical ability, with 1st or 2nd class honours degrees, for posts at a new research and development centre on the Nottinghamshire Oilfield. The work will involve theoretical investigation of the movement of fluids in oil reservoirs and problems connected with recovery of oil. Methods and equipment will be developed for electrical recording at surface of a wide range of physical observations on oil and gas bearing formations penetrated in deep wells. The observations include resistivity of formations, radio-activity, temperature, pressure, fluid velocity, well diameter, etc. The equipment will also be used for actuating sample devices and special bottom hole instruments. The mathematician will be concerned with oil reservoir future production performance and the mathematical physicist with the allied survey research and development work. The physicist will be responsible for interpretation of records and laboratory experiments, both electrical and physical, bearing on interpretation. Men with some years practical experience of electronics preferred for the two latter posts. Applicants aged from 27-35 years should be prepared to go abroad for periods extending to six months. Write, giving full details and quoting Department M. 1415 to Box 5982 at 191, Gresham House, E.C.2. E5166 A.

ANGLO-IRANIAN Oil Company have a vacancy for an ASSISTANT ENGINEER in this country, but he will be required to pay occasional visits overseas. Candidates must have either a civil or structural engineering degree or equivalent, and must have had practical design experience in steel and concrete structures. A knowledge of erection equipment and procedure would be an advantage. Write, giving full details and quoting Department M. 1404 to Box 5968 at 191, Gresham House, E.C.2. E5054 A.

APPLICATIONS are invited from University Graduates aged up to 30 years with an Engineering degree, for a vacancy as a JUNIOR ASSISTANT to the MANAGER of a branch works of a large manufacturing group. Applicants to be prepared to handle detail technical queries and correspondence, also to be suitable for training to take over some administrative duties. Persons resident in the West Riding area of Yorkshire preferred. Write, stating details of schooling and University education, details of technical and practical experience and of positions held. Address, E3543, The Engineer Office. A.

AN INTERNATIONALLY known firm in the light Engineering Industry has vacancies for three or four trained ENGINEERS to be prepared for works executive appointments. Applications will be considered from men aged about 30 with University degree and some experience of executive responsibility. Salaries are above average and the prospects up to approximately £3,000 per annum excellent. Please send full details of qualifications, posts held and salaries in confidence. Address, E5121, The Engineer Office. A.

APPLICATIONS are invited for a position in the office of the Works Engineer. Must be a capable DRAUGHTSMAN with experience in plant layout and design, factory services and buildings Technical qualifications to Higher National Certificate standard. Salary according to experience. Reynolds Tube Co.Ltd., Tyseley, Birmingham. E5519 A.

APPLICATIONS are invited by the British Electric Co. Ltd., for ENGINEERS having wide experience in the preparation of comprehensive and specialised schemes of machine control. Applicants must be of Higher National Certificate standard and capable of preparing schemes in detail. Apply, quoting reference 806 to Central Personnel Services, English Electric Co. Ltd., 24-30, Gillingham Street, London, S.W.1. E5090 A.

APPLICATIONS are invited by the English Electric Co.Ltd., Stafford, from young ENGINEERS of Graduate or Higher National Certificate standard with experience in the preparation of control gear wiring diagrams, for training as control gear engineers on specialised schemes. Selected applicants will, where necessary, be given a short course of training and will receive full pay during this period. The positions are permanent and progressive and afford excellent opportunities. Apply quoting ref. 805 to Central Personnel Services, English Electric Co.Ltd., 24-30, Gillingham Street, London, S.W.1. E5091 A.

ASSISTANT DESIGNER. Large Engineering firm in S.W.London require a man with experience in mechanical and electrical work, preferably medical equipment. Permanent employment and excellent prospects offered. Write stating age, experience and salary required to Box E.683, L.P.E., 110, St. Martin's Lane, W.C.2. E5028 A.

ASSISTANT ESTIMATING ENGINEER experienced in pressure vessel work and allied equipment and machinery for the Chemical and Petroleum Industries required by firm of Plant Manufacturers London area. Excellent opportunity for a man of ability and sound practical background. Write giving full details of experience and salary required. Address, E5049, The Engineer Office. A.

ASSISTANT WORKS ENGINEER required by very large light engineering company in London area. Applicants should be between 35 and 45 years of age and competent to handle maintenance of buildings, essential services and all types of plant and machine tools. The successful applicant must have practical and technical training and must be capable of controlling large staff. State in confidence full details of experience with age and salary required. Address, E5027, The Engineer Office. A.

ASSISTANTS required for Tea Estates in Northern India. Between 20 and 25 years, preferably unmarried with engineering experience, and keen agriculturist. Write with full details of education, experience, etc. to The Secretary, Matheson & Co.Ltd., 3, Lombard Street, E.C.3. E5082 A.

ASSISTANT GENERAL MANAGER required for moderate-sized but rapidly expanding London Engineering Company, specialists in hydraulic equipment and centralised lubrication. Post carries responsibility for control of production (mainly sub-contracted) and its co-ordination with Sales and Design Depts. Applicants must be competent mechanical engineers with previous experience at this level. Post offers prospects to man of initiative, able to get results. Commencing salary £850. State full details of training, experience and age, to Box 318, c/o Geo. Murray (Advertising) Ltd., 184, Strand, London, W.C.2. E5110 A.

BRITISH OXYGEN Co.Ltd., have a vacancy for FEMALE TRACER at their Head Office Applicants should be well qualified, with two to three years experience, between the ages of 18 and 21 years. This vacancy offers a good salary and provides an excellent opening. Please reply giving full details of age and experience to Dept. F., Bridgewater House, Cleveland Row, S.W.1. E5067 A.

BRITISH OXYGEN Co.Ltd., require at their Head Office, London, a JUNIOR PLANNING ENGINEER. Applicants should have a good University degree and have held positions dealing with design, development and installation of chemical plants including practical works experience. Apply giving full details of age, qualifications and experience to Dept. M. 74, Bridgewater House, Cleveland Row, London, S.W.1. E5079 A.

ASSISTANT METHODS ENGINEER wanted for progressive Mechanical Handling Company. Grand opportunity for young Production Engineer. Please state experience and salary. Address, E 3510, The Engineer Office. A.

CERAMIC PRODUCTION - MANAGER required to control manufacture of specialised electrical ceramics. First class experience in modern management methods (motion and materials economy production control and engineering), for achieving high efficiency in quantity production essential. Experience in similar industry desirable. Salary in accordance with qualifications and experience. London Area. Address, E5169, The Engineer Office. A.

CHIEF DRAUGHTSMAN required, experienced Press Die-Casting Moulds and Multi-Progression Press Tools. Small drawing office, Willesden area. Interesting and varied work. Salary region £600 p.a. Address, E3565, The Engineer Office. A.

CHIEF DRAUGHTSMAN required by Midland Manufacturers. All replies treated in strict confidence. Applications should state full details of qualifications, experience, and salary required. Address, E3514, The Engineer Office. A.

CHIEF PLANT DRAUGHTSMAN. Heavy Industrial company Coventry. Good mechanical and structural experience both practical and technical, able to control engineering drawing office, supervise layout and design. Progressive post. Staff Pension Scheme. Box No. 5277, Scotts, 9, Arundel St., London, W.C.2. E5167 A.

BRITISH RAILWAYS (Western Region) require for London Office DESIGNERS for reinforced concrete bridges and structures. Salary up to £630 according to age and experience. Knowledge of pre-stressed concrete desirable. Permanency and prospects of advancement for right man. Application with age, details of previous experience. Address, E5157, The Engineer Office. A.

BUILDINGS and Services Division controlling building work for large group of factories, require DRAUGHTSMAN. Experience in general building and structural work, surveying for site layouts, obtaining site details for modifications to existing buildings essential. Preference to men with knowledge of industrial engineering services. Staff Superannuation Scheme. Salary in accordance with experience. Write giving age, salary required and full particulars to Staff Division, The Metal Box Co. Ltd., The Langham, Portland Place, W.1. quoting Reference BS/12. E3560 A.

COURTAULDS LIMITED require an ASSISTANT COMBUSTION ENGINEER for their Engineering Headquarters at Coventry. Candidates should possess at least Higher National Certificate or its equivalent and must have had experience in the operation and/or testing of chain-grate fired water-tube boilers and the firing of Shell-type boiler plant, both for liquid and solid fuels. A knowledge of British coals and their combustion is desirable. Applicants should write for a detailed form of application to the Personnel Department, Courtaulds Limited, 16, St. Martin's-le-Grand, London, E.C.1. quoting the Ref. No. B.69. E5024 A.

COURTAULDS LIMITED require a CHIEF SERVICES ENGINEER to work directly under the Chief Engineer and be technically responsible for the specification, lay-out and operation of all services, including steam power plant, compressors, refrigeration and air conditioning (but excluding electrical services) in all the Company's Works throughout the United Kingdom. This is a Senior appointment for which a first-class theoretical background and wide experience of engineering services is essential. Candidates should write in the first instance to the Director of Personnel, Courtaulds Ltd., 16, St.Martin's-le-Grand, London, E.C.1. E5155 A.

COURTAULDS LIMITED require a SENIOR PLANNING ENGINEER for their Rayon Staple Fibre plant at Greenfield, N.Wales. The work will be in connexion with rayon producing machinery, chemical engineering plant, steam, power, refrigeration and similar large scale works services. Candidates should have a degree in Mechanical Engineering or a Higher National Certificate and have served an engineering apprenticeship. A wide experience of planning and progressing capital and maintenance work and some experience of incentive bonus schemes or time study is essential. Applicants should write for a detailed form of application to the Personnel Dept. Courtaulds Limited., 16, St. Martin's-le-Grand, London, E.C.1. quoting Ref. No. B.71. E5154 A.

CIVIL STRUCTURAL ENGINEER for large modern factory Manchester area. To be responsible for maintenance of factory buildings, roads, sidings, etc., under direct supervision of the Plant Engineer. Candidates should possess good technical qualifications and should have good general experience in supervision of the various building tradesmen. In addition he should have experience in budgetary control, estimating, scheduling of work and quantity specifications. The work also entails use of the various surveying instruments, knowledge of plans and preparation of stress calculations for steelwork and reinforced concrete. The appointment is on the Senior Staff and the Company operates an excellent Staff Pension Scheme and a free Life Insurance Scheme. Address, E5076, The Engineer Office. A.

CLANG Ltd., of Cricklewood, London require experienced SETTER for Swiss Automatics. Write or Phone GLA. 4201. Extn. 13. E5131 A.

CONTRACTS ENGINEER with mechanical qualifications required in London to assist in supervising production and inspection of large contracts for locomotives, rolling stock and heavy railway material. Only qualified and experienced men should apply, giving details and salary required. Box 105, c/o Dawsons, 129, Cannon Street, E.C.4. E5178 A.

AT the Head Office of the British Oxygen Co.Ltd., exist two vacancies for JUNIOR MECHANICAL ENGINEERING DRAUGHTSMEN. Applicants should have had experience of Plant Layout and Pipe work. The work will involve site visits. Canteen facilities. Minimum of Ordinary National Certificate desirable. Apply giving full details of age, qualifications and experience to Dept. M.79, Bridgewater House, Cleveland Row, St. James, S.W.1. E5055 A.

BRICK SUPERINTENDENT and ASSISTANT BRICK SUPERINTENDENT required for large Iron and Steel Works in India to take full charge of the lining and relining of modern coking plant, blast furnaces, fixed and tilting open hearth furnaces and reheating furnaces Apply, in writing, giving full details of experience, to Box No. 628, c/o Abbotts, Eastcheap, London, E.C.3. E3528 A.

CIVIL ENGINEERING CONTRACTORS in Liverpool (Kirkby) require STRUCTURAL STEEL DRAUGHTSMEN for the design of light frame structures. Age 22-30 years. Salary according to age and experience. Applications in writing, giving details of age and experience etc. Address, E5182, The Engineer Office. A.

CIVIL ENGINEERS with experience of sewerage or sewage disposal are required by Consulting Engineers in Westminster, salaries up to £1,000 per annum according to experience. Replies to Box No. E5072, The Engineer Office. A.

DESIGN DRAUGHTSMAN (SENIOR). First class man wanted for light mechanical work on Aircraft. Five day week. Pension & Life Assurance Scheme. Apply Employment Manager, Vickers-Armstrongs Ltd., Weybridge. E5125 A.

DESIGNER/DRAUGHTSMAN required for interesting work in plant developing and design. Experience in steel mill plant advantageous. Pension Scheme and 5 day week. Good prospects. Age, experience and salary required, experience, etc., to Personnel Manager, T.I.G.S. Ltd., Rocky Lane, Birmingham, 6. E5151 A.

DESIGNER/DRAUGHTSMAN for sluice and dock gates wanted. Reply in writing giving technical qualifications, experiance and salary required to Head Wrightson & Co., Ltd., 20, Buckingham Gate, London, S.W.1. E5078 A.

DESIGNER with experience of both passenger and commercial vehicles urgently required by a Midland Commercial Vehicle Manufacturer. Apply giving details of training, both practical and technical, and experience to Address, E3545, The Engineer Office. A.

DRAUGHTSMAN/ENGINEER with experience of installation and maintenance of large high pressure pulverised fuel boilers, auxiliary plant and pipe lines, required by large manufacturing organisation in London area. Permanent appointment, good working conditions and non-contributory Pension Scheme. Reply to Address, E5056, The Engineer Office, quoting reference SPD/CED and stating age, detailed account of experience and salary required. A.

DRAUGHTSMAN for Old Established Dudley Engineering firm; experienced in Constructional Engineering and Pressure Vessel design in Stainless Steel, etc. Canteen facilities. State age, qualifications and salary required. Address, E3533, The Engineer Office. A.

DRAUGHTSMAN required immediately, preferably with experience in Hydraulic Engineering, Qualifiactions: Higher National Certificate or equivalent. Good prospects for suitable applicant. Apply: Finney Presses Limited, Berkley Street, Birmingham, 1. E3549 A.

DRAUGHTSMAN required for permanent staff in Glasgow area for work on special equipment for power plants and oil installations. Write full particulars of age, experience and technical training to The Assistant Secretary, Stewarts and Lloyds, Ltd., 41, Oswald Street, Glasgow, C.1. E3532 A.

DRAUGHTSMAN. Senior and Junior required. Experienced in Cranes, Hoists and Winches, power and hand, both structural and mechanical. Write briefly in first instance giving age and experience. R.C. Gibbins & Co., Ltd., Berkley Street, Birmingham, 1. E5172 A.

DRAUGHTSMAN required for work on the design of plant and ancillary equipment, including ovens and conveyors used in the production of arc welding electrodes. Applicants should have some experience of hydraulic machinery and good general mechanical knowledge. Technical qualifications, O.N.C. minimum, age about 24 years. 5-day week. Apply, Address, E3564, The Engineer Office. A.

DRAUGHTSMAN required in Civil Engineer's Office; knowledge of steel and/or concrete design. Salary according to experience and ability. Position is pensionable and permanent. Apply in first instant to J.L.Eve Construction Co. Ltd., 53, Plough Lane, Wimbledon, S.W.19. E3563 A.

DRAUGHTSMAN required with ten to twenty years experience in drafting and design with preference for experience in general mechanical engineering and machine tool work. Automobile, electrical or jig and tool experience also an advantage. Applicant with Higher National Certificate and having served an apprenticeship with shop experience will be preferred. The position offers permanency with considerable variety of work, good working conditions, five day week and opportunities for advancement to capable and energetic applicants. Apply in writing giving age, full experience, qualifiactions and salary required to Personnel Manager, Fort Dunlop, Erdington, Birmingham, 24. E5046 A.

DRAUGHTSMAN required - experienced senior - centrifugal and axial flow fans, layouts and details. Write full details Air Control Installations Ltd., Ruislip, Middlesex. E5141 A.

DRAUGHTSMAN required by Tyneside firm engaged on marine auxiliaries. Experience on A.C. and D.C. machines or control gear. Write stating age, experience, qualifications, etc. Address, E3570, The Engineer Office. A.

DRAUGHTSMAN, SENIOR; experience of lift or crane work desirable, but not essential. Applicants should for preference be equal to Higher National Certificate standard. Firm now in London area, will shortly move to Crawley New Town (Sussex) where house to rent can be provided for successful man. Address, E3531, The Engineer Office. A.

DRAUGHTSMEN urgently required for Research Department, Vickers-Armstrong Limited, Barrow-in-Furness with good general experience in Mechanical Engineering, preferably Marine Engineering. Good salaries paid to suitable men. Apply, giving full particulars of experience to Senior Personnel Officer, King's Gate. E5036 A.

ELECTRICAL ENGINEER having experience in E.H.T. and L.T. distribution layouts required for Works Engineers department of large industrial concern on outskirts of Birmingham. Higher National Certificate desirable. Salary according to qualifications and experience. Address, E5148, The Engineer Office. A.

ELECTRICAL ENGINEER - SENIOR. A progressive and expanding company in the London area desires to appoint a senior Electrical Engineer at executive level. The appointment will involve a responsibility for design and development of electrical apparatus, mainly small transformers and a wide experience of design of all types is essential. The individual appointed will also be required to supervise all experimental work. A first class degree in

electrical engineering and/or membership of the I.E.E. is an essential requirement, coupled with several years practical design and manufacturing experience with one of the reputable electrical manufacturing companies. This appointment is an important one and will carry substantial remuneration to a man with the requisite experience and ability. The lower age limit will be 30 years. Applicants who can fully substantiate their claim should state fully details of their technical training, practical experience, previous and present appointments and salaries, salary required and age. Applications will be treated with the strictest confidence addressed for the personal attention of the Managing Director, Address, E3554, The Engineer Office. A.

ENGINEER aged 23-30 years required by young and expanding engineering concern in the Midlands. Minimum qualifications: Higher National Certificate, good practical training and background, preferably with experience of machining processes, press work or tool design. A high degree of initiative will be required of the successful applicant and some experience of report writing would be an advantage. The position will necessitate a certain amount of travel within the U.K. Full particulars including salary required to: Address, E5129, The Engineer Office. A.

ENGINEER DRAUGHTSMAN with knowledge of hydraulic design and manufacture to help in the development of a range of hydraulic valves and ancillary equipment mainly for high pressure working. Address, E5075, The Engineer Office. A.

ENGINEER GRADUATE. Applications are invited from Engineers with a 1st or 2nd Class Honours Degree desirous of a career in the Production Department of a large scale manufacturing Company. Industrial experience is desirable but not essential as comprehensive training will be given for the appointment, an essential of which is specialisation in motion study work. The successful candidate will be given every opportunity to become an expert in this field which offers a promising career to a man with energy and ability to apply himself. Salary will depend upon qualifications. Apply in writing to the Personnel Manager, British Nylon Spinners Limited, Pontypool, Mon. E3508 A.

ENGINEER required for project office. Preferably with knowledge of fan engineering, heat transfer or radiator equipment. Able to deal with correspondence. Write, giving full details of qualifications and experience and stating salary required to Personnel Manager, Serck Radiators Limited, Warwick Road, Birmingham, 11, marking envelope E/U. E5173 A.

ENGINEER SALESMAN (35-50) required by large engineering Company in Slough for developing and introducing a product previously imported, used by Steam Power Plants, Chemical Works and Marine Engineers. Minimum qualifications are Associate Membership of an Engineering Institution, practical experience of design or operation of steam plants and some commercial experience. Knowledge of German desired. Salary to commence £800 per annum but plenty of scope for advancement. Send full particulars of education and career to: Address, E5086, The Engineer Office. A.

ENGINEERING ASSISTANTS with experience of design of harbour and general civil engineering works required by Consulting Engineers in Westminster. Salary according to experience. Apply stating age and experience: Address, E3505, The Engineer Office. A.

ENGINEERING TECHNICAL ASSISTANT required, preferably with electrical experience. Salary £510 - £555 p.a. Application forms obtainable from Chief Engineer, Board of Governors, Hammersmith, West London and St. Mark's Hospitals, 150, Du Cane Road, London, W.12. E5059 A.

EQUIPMENT ENGINEER required for rubber factory in S.W. England. Applicants must have good technical training and be experienced in design of special purpose machines, jigs and moulds as applied to the Rubber Industry. Apply stating age and full particulars of qualifications, experience and salary required to: Address, E5035, The Engineer Office. A.

EXPERIENCED DRAUGHTSMAN required S.W. London. Knowledge of Refrigeration and Food Factory layout preferred, but not essential. Good conditions. 5 day week. Must be capable of handling complete plants on own initiative. State age, experience and salary required. Address, E3550, The Engineer Office. A.

EXPERIENCED ERECTION ENGINEER required for major extensions to a chemical plant at Grimsby. Applications stating professional and technical qualifications, together with full details of previous experience should be addressed to British Titan Products Co., Ltd., Kronos House, Coppergate, York. E3568 A.

EXPERIENCED JIG AND TOOL DRAUGHTSMAN required by Edinburgh firm. Apply: Address, E3552, The Engineer Office. A.

EXPERIENCED SENIOR DRAUGHTSMEN for Constructional Steelwork. Write stating age, experience and salary required to: Address, E3555, The Engineer Office. A.

FOUR DESIGNER DRAUGHTSMAN having initiative and broad engineering experience required in S.W. district by manufacturers of chemical engineering and process equipment. Permanencies for suitable applicants. Attractive pension scheme. Please state age, experience, salary required, etc. Address, E3540, The Engineer Office. A.

GRADUATE ENGINEER (Elec.) required aged 26-28 to act as Assistant to Electrical Engineer in large factory - London area. Full details of age, experience, technical qualifications and salary required to: Address, E3556, The Engineer Office. A.

GENERAL MANAGER required for branch Engineering Works in Scotland. Production, design and commercial experience essential. Excellent opportunity for suitable man. Age 40-50. Apply, giving full details of experience and salary required to: Address, E3520, The Engineer Office. A.

GRADUATE required for metallurgical laboratory in Westminster area. The laboratory deals with the mechanical testing and examination of a very wide range of materials and offers ample scope for the acquisition of practical experience. Initial salary in the order of £300 - £350 per annum. Write R.H.H.Stanger, 28, Tothill Street, London, S.W.1. E3536 A.

GRADUATES IN ENGINEERING (B.Sc. or equivalent) are required for training to positions of responsibility in the following departments of a General Engineering Company in Lancashire: (1) Technical Sales Engineering. (2) Production Control. (3) Design and Development. Candidates should give full particulars of education, qualifications and experience, stating age and salary required to: Address, E3515, The Engineer Office. A.

GROUP of established Glasgow manufacturers wish Scotsman with mechanical and chemical engineering experience to act for them in Canada. Applicants should be under 40 and able to deal with all grades of engineers and buyers. Appointment for two years in first instance. Replies, marked "Canada", should be sent to the Managing Director, The Engineering Centre Ltd., 351, Sauchiehall Street, Glasgow, C.2. E5073 A.

INGOT SALES MANAGER - male or female - to co-ordinate, develop and control the sale of Brass and Bronze ingots, Home and Export. Experience of Ingot manufacture and statistics desirable. Substantial salary, Bonus, Life and Pension Fund. Write stating experience, age, and salary required to: Address, E5170, The Engineer Office. A.

IMPERIAL CHEMICAL INDUSTRIES LIMITED, WILTON WORKS, Nr. Redcar, Yorks., require a Boiler Plant Manager to take charge of the operation and maintenance of a new large high pressure (925 lb./in^2 925° F) boiler installation using pulverised fuel, with which is associated back pressure and pass-out turbines for power generation. Initial installed capacity 520,000 lb./hr. Applicants should have a University Degree or equal technical qualifications, and must have previous experience of the operation of water tube boilers. Starting salary will be dependent upon qualifications and experience. Applications should be submitted in writing to the Staff Officer, Imperial Chemical Industries Ltd., Wilton Works, P.O. Box 54, Middlesbrough, Yorks., quoting advertisement reference ICI/X/70(a) E5060 A.

JIG AND TOOL DESIGNERS. Several vacancies open in West London area for designers experienced in aero-engine or comparable work, able to produce on own initiative schemes for detailing. Write giving details of experience, etc. to Box A.E.107, c/o. Central News Ltd., 17, Moorgate, London,E.C.2. E5165 A.

JIG AND TOOL DRAUGHTSMAN required for Mass Production Works in East Riding, some knowledge of special Machine design and practical experience desirable. Good working conditions with Canteen facilities. Bonus scheme in operation. Address, E3526, The Engineer Office. A.

JIG AND TOOL DRAUGHTSMAN required for general machine shop work - position suitable for young man out of his time and free from call-up. Training given to likely candidate. Country district. Write full particulars to R.A.Lister & Co. Ltd., Employment Office, Dursley, Glos. E5095 A.

JUNIOR ENGINEER required to take charge of maintenance and development of Re-rolling Mills situated in the north of England. Accommodation available. Apply stating age and experience to: Address, E3542, The Engineer Office. A.

JUNIOR ESTIMATOR required urgently for calculating weights quickly from detail drawings. Apply: Address, E5132, The Engineer Office. A.

JUNIOR REFRIGERATION ENGINEER required for London district. Preferably between the ages of 22 and 26 years. Must have sound qualifications and practical knowledge. Good opportunities for advancement. Write: Address, E5156, The Engineer Office. A.

LIVE WIRE MAN for sales organisation of Bolts, Washers, etc. Knowledge of trade and with connections. Good salary and commission, excellent prospects. Box No. "Bolts", E5051, The Engineer Office. A.

LONDON ENGINEERING Public Company, 1200 employees, requires PLANNING & DEVELOPMENT ENGINEER with experience of Plant Layout, to assist in Planning and improving production methods. Age 30-35. Should have served apprenticeship and a technical qualification is desirable. Write stating full details of experience and positions held and present salary to: Address, E3500, The Engineer Office. A.

MAINTENANCE FOREMAN wanted. For large industrial Milling concern in East Anglia, age 35/45. Wide experience essential of practical side of various trades, including Turning, Canister Diemaking, Fitting, Millwrighting and general installation work, preferably connected with maintenance in food factories. Some knowledge of the theory of Engineering practice desirable. Apply giving age, qualifications, experience and salary required. Address, E3521, The Engineer Office. A.

MANAGEMENT and Industrial Consulting. Production-Engineering Ltd., invite applications from qualified Engineers preferably with university degrees and with a real interest in the problems facing management today. There are exceptional openings for first class men with initiative requiring permanent posts in this type of work. Applicants should have served an apprenticeship, and should also have had good practical experience and held an executive position in industry. After training, there is a four figure starting salary as well as Life Assurance and superannuation schemes. Applicants should be between 27 and 35. Write, giving age and full details of education, qualifications and experience, to Production-Engineering Ltd., 28, Bruton Street, London,W.1. E3522 A.

MECHANICAL ENGINEER wanted to take charge of small workshop and field maintenance of contractors plant. Should have had training as a draughtsman with experience in electric welding and machine shop practice, and knowledge of petrol and diesel engines. Opportunity of permanent job for young man with energy and initiative. Salary £400/£450 p.a. depending on experience. Apply: W.A.Dawson Ltd., Civil Engineering Contractors, Sundon Park, Luton, Beds. (Luton 3803). E3511 A.

MIDLAND MANUFACTURERS of heavy engineering equipment require YOUNG ENGINEERS for service abroad, 18/24 months pre-training in Drawing Office; Project Department, site erection and plant operation essential. Apply giving particulars of training and experience to: Address, E5098, The Engineer Office. A.

OIL COMPANY in Trinidad B.W.I. requires ASSISTANT ENGINEERS; practical men who have served a full apprenticeship and who have at least five years experience on maintenance work in oil refining chemical plant, or merchant marine (Chief Engineers Certificate). A good technical education is essential. Age not exceeding 35. Salary range £675-975. Marriage and family allowances paid. Excellent staff amenities. Apply with full particulars to: Address E5163, The Engineer Office. A.

OPPORTUNITY. A vacancy for a full time working DIRECTOR and GENERAL MANAGER has occurred in one of the best known old established London Machinery Trading concerns, with well equipped Engineering works. Gentlemen of good education, outstanding ability and first class commercial engineering experience are requested to give details, in confidence, stating also if they would be interested in acquiring a Shareholding at a cost of about £25,000 which could be made available. Write Box 4199 Frost-Smith Advg., 64, Finsbury Pavement, London, E.C.2. E5084 A.

PRODUCTION MANAGER required by large light electrical engineering concern in London area. Applicants who should possess technical qualifications to B.Sc. standard in electrical engineering or physics, must have had experience of the control of female labour engaged on the mass production of light assemblies. To a man between the age of 30 and 40 possessing drive and human understanding a permanent pensionable position is available. Kindly state full details, including age and salary required to: Address, E5179, The Engineer Office. A.

POSITIONS available in East Africa as ASSISTANT TEA FACTORY MANAGERS for young men with engineering qualifications. Full details on application to: Address, E3553, The Engineer Office. A.

PRESS TOOL DESIGN DRAUGHTSMAN required by medium-sized Company engaged in light engineering. An excellent opportunity for a fully experienced man, capable of working without supervision. Details of training, experience, and present salary to: Address, E3566, The Engineer Office. A.

PRODUCTION ENGINEER. A first class man required for production of commercial and passenger vehicles. Applicants will be expected to show a successful record in similar positions and a salary commensurate with ability and experience will be paid. Applications must be made in writing giving full details of age, positions held in chronological order, and salary required to: Personnel Manager, Tilling-Stevens Ltd., Victoria Works, Maidstone, Kent. E3557 A.

REINFORCED CONCRETE DESIGNER required on interesting and varied work. Salary will be considered on qualifications and experience. Appointment is not of a temporary nature. Applications treated in confidence if desired. State full details, qualifications, experience and age to: Sir Alexander Gibb & Partners, Queen Anne's Lodge, Westminster, London, S.W.1. E3546 A.

REINFORCED CONCRETE DRAUGHTSMAN required. Experience in structural steelwork useful. Salary will be considered on qualifications and experience. Appointment is not of a temporary nature. Applications treated in confidence if desired. State full details, qualifications, experience and age to: Sir Alexander Gibb & Partners, Queen Anne's Lodge, Westminster, London, S.W.1. E3547 A.

REPRESENTATIVE required for Yorkshire and North Eastern Counties to handle excavators, cranes, locomotives, and other contractor's plant, also new E.O.T. Cranes. Particulars of training, sales experience, age and salary required to: Address, E5105, The Engineer Office. A.

REQUIRED - TWO JUNIOR CIVIL ENGINEERS 22 years to 25 years, experienced in Civil Engineering for steelworks. Knowledge of reinforced concrete, design, building work, excavations, general maintenance and lay-out of railways. State salary required and when available. Write General Manager, Iron & Steel Works, Messrs. Stewarts and Lloyds Limited, Corby, Northants. E5077 A.

RESEARCH ENGINEERS or Engineer Physicists are required by an important steam and gas turbine organisation for experimental and theoretical work on the following subjects: (1) Aerodynamics and Heat Transfer; (2) Full Scale Testing of Turbine Machinery; (3) Gearing Research and Development; (4) Vibration Problems. They should possess an honours degree or equivalent in engineering or allied subjects. Age 23-28. Salary according to age and experience. Write: Address, E5150, The Engineer Office. E5150 A.

SALES ENGINEERS required for North Eastern and North Western England, with connections among Engineering Works, Plant users, etc., by leading specialised lubrication Company expanding its sales staff. Salary, commission and expenses paid. Applicants should state age, engineering and sales experience, and remuneration required. Address, E3562, The Engineer Office. E3562 A.

SALES REPRESENTATIVE wanted for London Should have preferably a knowledge of Pneumatic Tools and a good technical training. Applicants are requested to give full particulars of their qualifications, previous experience, age and approximate salary required. Apply to John Macdonald & Co. (Pneumatic Tools) Ltd., 175, Shawbridge Street, Pollokshaws, Glasgow, S.3. E5116 A.

SENIOR AND JUNIOR DRAUGHTSMEN, preferably with experience in Chemical work, required for large scale project in Yorkshire. Excellent prospects for first-class applicants in both categories. Replies, which will be treated in confidence, to the Chief Engineer, Synthetic Chemicals Limited, Knottingley, Yorkshire. E3538 A.

SENIOR AND JUNIOR STRUCTURAL DRAUGHTSMEN required by Bath Consulting Engineers, above union wages will be paid to experienced applicants. Address, E5134, The Engineer Office. A.

SENIOR DESIGNER required by the Rootes Group Truck Plant in Luton or Coventry Applicants must have a wide experience of medium and light commercial vehicle design. Permanent position with good salary and pension scheme. Please apply in writing giving full particulars to The Secretarial Department, Commer Cars, Limited, Luton. E3491 A.

SENIOR VENTILATION DRAUGHTSMAN required for London Office, preferably having had experience in preparing schemes and estimates. Good working conditions, 40-hour week and Pension Scheme. Salary, according to age and experience to: Address, E3513, The Engineer Office. A.

SENIOR DRAUGHTSMAN required by well-known Mechanical Engineers in London area. Must have sound technical engineering training and experience in the design of boiler mountings and auxiliary fittings. 5 day week. Pension fund. Apply stating age and full particulars of training, experience and salary required. Address, E5162, The Engineer Office. E5162 A.

SENIOR DRAUGHTSMAN required for large industrial plant in East Midlands. Applicants must have full experience in General Engineering work. Good prospects and permanence to the right men. Apply: Address, E5160, The Engineer Office. A.

SENIOR DRAUGHTSMAN trained and experienced in heavy engineering industry: capable of design of fabricated work, or chemical plant, or heavy hydraulic machinery. Estimating experience an advantage. Good technical background to at least Higher National Certificate standard essential. Good salary, comfortable office in Lancashire. Reply stating details of education and experience in chronological order to: Address, E3548, The Engineer Office. A.

SENIOR DRAUGHTSMEN DESIGNERS required with experience in rolling mills and auxiliaries for the steel and non-ferrous industries. Apply: Chief Draughtsman, The Head Wrightson Machine Co. Ltd., Commercial Street, Middlesbrough. E5135 A.

SENIOR DRAUGHTSMAN experienced in the design of electro-mechanical apparatus required for high priority work in the Gloucester district. Excellent salaries paid, Address, E5133, The Engineer Office. A.

SENIOR DRAUGHTSMAN, experienced in General Mechanical Engineering, required for maintenance work on Wire Drawing and Cable Making Machinery. Remuneration according to age, ability and experience. Five day week, superannuation scheme. Applications in writing should be forwarded to the Staff Officer, B.I.C.C. Ltd., Prescot, Lancs. E5122 A.

SENTINEL (Shrewsbury) Ltd., Shrewsbury have vacancies for EXPERIENCED DRAUGHTSMEN in the Motor Vehicle Chassis Department, New Models. Pension Scheme, Social Club and good lodgings available. Applicants should state age, experience and qualifications. Apply to: "Technical Director", Sentinel (Shrewsbury) Ltd., Engineers, Shrewsbury, Shropshire. E3558 A.

SHEET METAL ENGINEER required for a Senior Appointment with a Company in the Home Counties producing a variety of medium and small sheet metal products and assemblies. The selected applicant must be over 40 years of age, and will be answerable to the Board of Directors. He must have ability, initiative and experience of accepting full responsibility for design, estimating, and tool design for certain new products. Preference given to apprentice-trained man with practical tool room and tool try-out experience, followed by a successful record of estimating and process planning in light engineering. Substantial salary will be paid to the right man. Apply in first instance, stating full particulars of training, experience, and positions held, together with salaries received, in confidence to: Address, E3567, The Engineer Office. A.

SOUTH AFRICA. DRAUGHTSMEN. Several men required for an important engineering firm in Johannesburg but applications will only be considered from men having sound experience in the layout and design of reduction and treatment plants and/or crushing, screening and material handling installations including the design and detailing of the relevant structures, foundations, etc. Salary up to £65 per month according to qualifications plus cost of living allowance at present £13.7.6. per month. Engagement on 3 year contract. Travelling expenses paid plus 20/- per day and half salary during the journey out. Apply in writing to O. O. Schmitt, 272, Russell Court, Woburn Place, London, W.C.1. E3504 A.

SOUTHERN FORGE LIMITED of Langley, Bucks., require a young ENGINEERING DRAUGHTSMAN for the design of production-equipment and detailing plant layout, etc. Must be capable of working on his own initiative. Experience of similar work in aluminium extrusion and forge shops would be an advantage. Apply in writing giving details of qualifications, experience and salary required to Personnel Manager, Southern Forge Limited, Meadfield Road, Langley, Bucks. E3517 A.

STRUCTURAL ENGINEER required to act as MANAGER in charge of steelwork and demolition contracts in a medium-sized but rapidly expanding company. Applicants must be prepared to work hard, and to take complete charge of their department. Prospects are very good, and it is essential that only men of first class character and proved ability apply. Details in the first place to: Address, E5137, The Engineer Office. E5137 A.

STRUCTURAL ENGINEER required to act as MANAGER in charge of steel-shop production in a medium-sized, but rapidly expanding company. Additional to this he will be responsible for the buying of all consumable goods as well as for the efficient control of stocks, records, etc. This is an excellent opportunity for an energetic and capable executive, prepared to work hard and only men of first class ability need apply. This post carries with it the possibility of promotion to WORKS MANAGER, and details should be sent in the first instance to: Address, E5138, The Engineer Office. A.

TECHNICAL AND SALES REPRESENTATIVE with thorough knowledge of non-ferrous castings. Good engineering connections are essential. Age under 40. Progressive and permanent for keen and conscientious applicant. Write stating previous experience, age, salary required to: Address, E5063, The Engineer Office. A.

TECHNICAL ASSISTANT required, good technical training and knowledge of Heat Exchange Apparatus for Distillation Plants and other Boiler Feed Auxiliaries for Marine and Industrial Installations. Write, Caird & Rayner, Ltd., 777, Commercial Road, E.14. E3551 A.

TECHNICAL REPRESENTATIVE. Well-known engineering Company is enlarging its selling staff and a vacancy occurs for London and the Home Counties area. Applications are invited from engineers with good knowledge and experience of non-ferrous metals, internal combustion engines and industrial machinery generally. Applicants should write, stating age, experience and salary desired to: Address, E3561, The Engineer Office. A.

THE BRIMAR Valve Works require a SENIOR PLANNING ENGINEER. Knowledge of valve manufacture an advantage but not essential. Write giving particulars of age, experience and salary required to Personnel Officer, Standard Telephones and Cables Limited Footscray, Sidcup, Kent. E3516 A.

THE BRITISH Oxygen Company Limited has vacancies in their Edmonton Technical Dept., and invite applications for the following:

SENIOR MECHANICAL DESIGNER-DRAUGHTSMAN with experience in design of small special purpose machines and equipment Some electrical knowledge an advantage but not essential.

SENIOR MECHANICAL DESIGNER-DRAUGHTSMAN with experience in design of reciprocating gas compressors and/or rotary and reciprocating hydraulic pumps.

SENIOR MECHANICAL DRAUGHTSMAN for layout and detail drawing work on Gas Separation Plants. Previous experience on this class of work is not essential and men with suitable technical qualifications and good mechanical drawing office experience will be considered.

JUNIOR MECHANICAL DRAUGHTSMAN. Age 21-25. Education to O.N.C. standard and at least 2-3 years practical D.O. experience.

Five-day week, Staff Pension Scheme, initial salary according to experience and qualifications. Applications, stating age, experience and salary expected should be addressed to: The Personnel Dept., The British Oxygen Co. Ltd., Angel Road, Upper Edmonton, London, N.18. E5168 A.

THE following vacancies exist in Wiltshire, at a light Engineering Works employing approximately 2,000 people.

ASSISTANT CHIEF INSPECTOR. Must have considerable mechanical and some electrical experience, having held similar position with A.I.D. approval. Experience of commercial work particularly in reference to Automatics. Age 35 - 45 years.

CHIEF JIG AND TOOL DRAUGHTSMAN. Drawing office personnel of 12. Age 30 - 45 years.

PERSONNEL MANAGER. Responsible for all engagements male and female. T.U. negotiations. Factories acts. Welfare. Preferably corporate member of I.P.M. Age 30 - 45 years.

Applicants who have held similar positions to the above are asked to forward full details regarding age, experience and salary required to: Address, E5089, The Engineer Office. E5089 A.

TRANSFORMER TEST ENGINEERS required for work on Test Bed of a large Midlands Manufacturer. Applicants should preferably have had previous experience on medium sized power transformers, and some experience with instrument transformers would be an asset. Excellent opportunities for advancement under good working conditions for the right type of man. Reply giving details of experience, age, salary required, etc., to: Address, E5181, The Engineer Office. A.

TWO JIG AND TOOL DRAUGHTSMEN required by well-known Mechanical Engineers in London area. Must have sound technical engineering training including machine shop experience. 5 day week. Pension fund. Apply stating age and full particulars of training, experience and salary required to: Address, E5161, The Engineer Office. A.

VAUXHALL Motors Ltd., Luton require a PLANT MECHANICAL ENGINEER. Applicants must have had sound practical training with proved experience in all aspects of Plant Mechanical Service, Compressed Air and Producer Gas, as applied to a Large Mass Production Factory. Must be a good organiser with drive and initiative and be capable of handling skilled and semi-skilled labour, and preferably be a corporate member of the Institution of Mechanical Engineers. Applications should be submitted with details of previous employment and positions held in chronological order date of birth, etc. Salary will be according to experience and ability. This is not a temporary appointment, but offers a long term engagement to a suitably qualified man. Applications to Route 215, Vauxhall Motors Ltd., Kimpton Road, Luton. E3535 A.

VICKERS-ARMSTRONGS LTD., Elswick Works, Newcastle upon Tyne, has vacancies in their Research Department for YOUNG MEN with experience in hydraulic, electronic or mechanical design and development. Candidates should have a Degree or Higher National Certificate, and salary will be in accordance with experience and qualifications. The work includes trials, development of automatic controls, improvement in hydraulic machines and stress analysis, and applicants should state their preference. Applications should be addressed to the Personnel Officer. E5147 A.

SITUATIONS WANTED

WANTED EXPERIENCED MECHANICAL DRAUGHTSMAN. Christy & Norris Ltd., Chelmsford Telephone 3414. E3569 A.

WORKS MANAGER for structural engineers, London area; 1st class practical man with experience all branches good organiser, strict disciplinarian. Only men having held similar positions need apply. State age, experience and salary required to: Address, "C" Eng. E5164, The Engineer Office. A.

YOUNG ASSISTANT ENGINEER required for experimental and development work. Honours graduate preferred. Age, full particulars of qualifications and experience and salary required to Staff Office, Rowntree & Co. Ltd., York. E3518 A.

A HIGH EXECUTIVE in the motor industry at present controlling chassis production at a salary of approximately £2,000 p.a. would welcome alternative office. Write Box Z.J.150, Deacon's Advertising, 36 Leadenhall Street, E.C.3. E5039 B.

A MECHANICAL and ELECTRICAL ENGINEER, B.Sc., standard, age 34, with home and export business experience and sound technical background, knowledge of languages, desires change. Address, E3499, The Engineer Office, B.

A.M.I.Mech.E. 34 years of age, Public School education, seeks position as an ASSESSOR with well established Industrial Insurance Company. Fourteen years varied light Engineering experience at home and abroad. Strong personality and appearance. Address, E3492, The Engineer Office. B.

A.M.I.Mech.E., A.F.R.Ae.S., 34 years of age, single, thirteen years experience both Technical and Practical seeks position with reputable firm on Technical Sales Staff or on Liason at home or abroad. Three years Continental experience, smart appearance and address, languages French and German. Address, E3493, The Engineer Office. B.

B.Sc. (Eng.) First Class Hons. (27) Eight years experience civil engineering including two years soil mechanics desires position London consultants. Address, E3507, The Engineer Office. B.

ENGINEER (33) G.I.Mech.E. First class M.of Transport Motor Certificate. Just returned from three years construction work abroad. Experienced works, D.O. plant installation, running and maintenance all sizes. Diesel engines and American Diesel-Electric Locomotives. Seeks progress. position as WORKS or SALES ENGINEER. Address, E3503, The Engineer Office. B.

ENGINEER, practical, First class B.of T. Certificate, M.I.Mhr.E. experienced steam, diesel, power plant and gen. workshop, drawing office and design, labour control, office routine. Thirteen years charge factory maintenance and inatallation. Desires similar position. Not afraid of hard work. Address, E3579, The Engineer Office. B.

GENERAL WORKS MANAGER, 46, A.I.I.A. General and constructional engineering boilermaking, road making and quarry plant vibrating screens, chassis trailers etc. Keen, tactful administrator proven results. Free due to change of ownership. Any district considered. Address, E3529, The Engineer Office. B.

GRADUATE B.Sc.Mech.Eng. London Ex-Armoured Corps Officer age 27 seeks position, preferably research/design-development in light industry but anything considered. Address, E3506, The Engineer Office. B.

GRADUATE Electro-Mechanical Engineer, A.M.I.E.E. with long experience in control equipments, very resourceful and energetic, seeks senior appointment. Address, E3496, The Engineer Office. B.

MECHANICAL ENGINEER, 32, A.M.I.Mech.E. indentured apprenticeship on aero-engines. Drawing office, planning, tooling, development experience on engines, vehicles, special machinery. Ex-R.E.M.E. workshop officer. Recently returned from overseas position as Technical Assistant to Managing Director, available immediately. What offers? Address, E3497, The Engineer Office. B.

PURCHASE MANAGER 35. Thoroughly experienced in sound competitive purchase all types materials, etc. Well established personal contacts with suppliers. Address, E3498, The Engineer Office. B.

SENIOR EXECUTIVE, 35, with first class cost and financial accounting qualifications and experience of production methods and administrative techniques, now Secretary of Public Company and subsidiaries. Desires change as comptroller or commercial manager with prospects of executive directorship of engineering company requiring intelligent financial control of organisation. Address, E3501, The Engineer Office. B.

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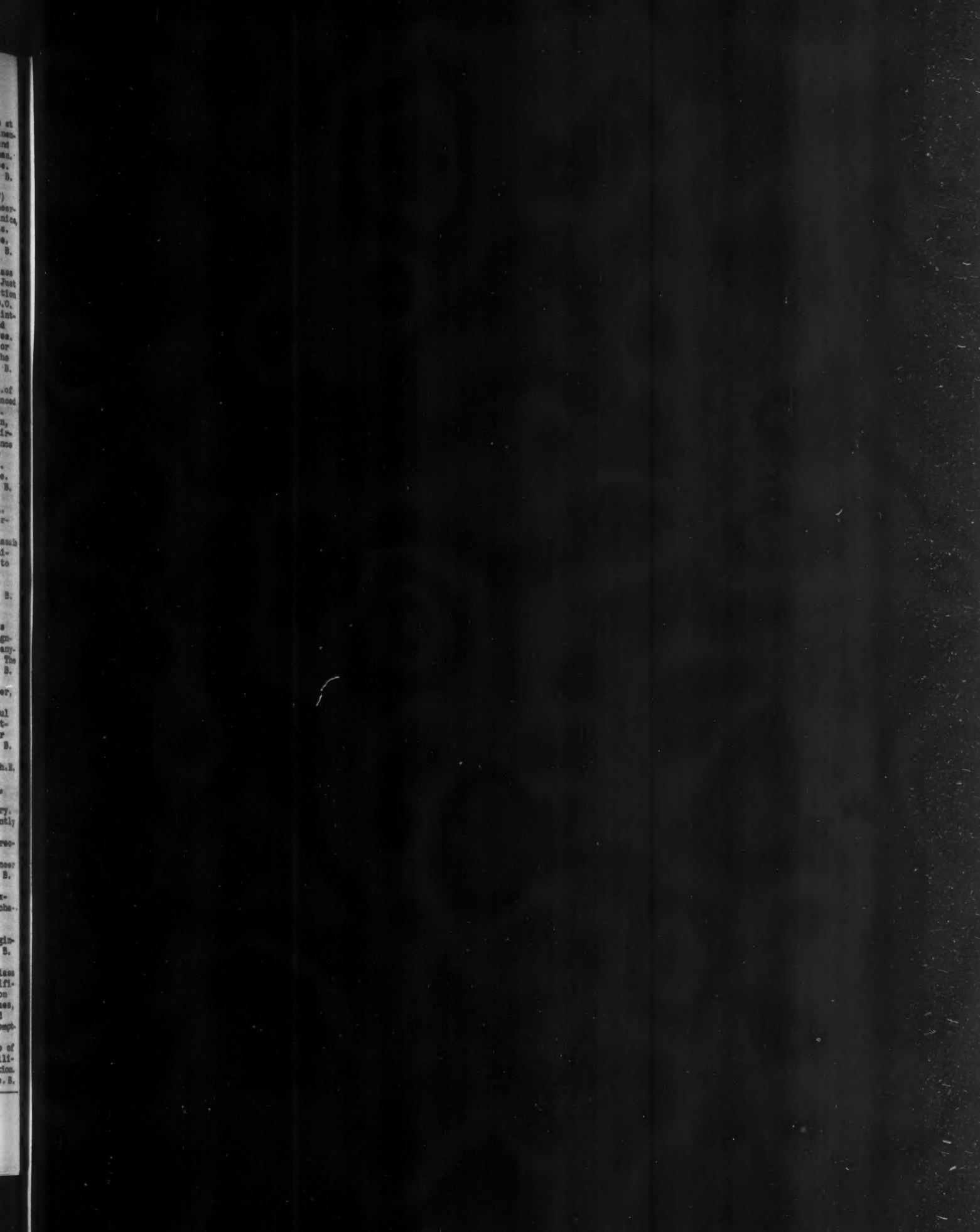


Productivity in British Industry*

No. XIV—THE CONTRIBUTION OF THE MACHINE TOOL INDUSTRY

By J. B. S. GABRIEL†

BEFORE considering what contribution the machine tool industry has made to the productivity of British industry as a whole, it might be as well to survey quickly this particular industry, which, like the railways, was cradled in this country and made possible the industrial age.

First of all, let us establish what we mean by the machine tool industry. There is frequently misunderstanding on this point, largely due to three factors :—

(a) During the war the Machine Tool Control gathered under its wing metal-cutting and forming machine tools as well as woodworking machinery, steel works plant, die-casting machines and many other allied lines not normally regarded as machine tools.

(b) The Machine Tool Trades Association embraces both manufacturers of metal-cutting and forming machines and wood-working machinery and allied trades.

(c) The Machine Tool Advisory Council deals with both metal-cutting and forming machine tools and woodworking machinery.

For the purposes of this article, it is proposed to use the term "machine tool" in its more restricted sense as a metal-cutting and forming machine, but excluding those heavy hydraulic presses and other machines designated as steel works plant. Even so, there is a wide range of machine tools, which may be divided into twenty main groups, listed below approximately in the order of their size as regards value :—

Lathes
Presses
Drilling Machines
Capstans and Turrets
Grinding Machines
Miscellaneous
Milling Machines
Automatics
Boring Machines
Shear Plate and Sheet Machines
Low Cost Machines (under £75 in value)
Shapers
Gear Machines
Planers
Saw and File Machines
Screwing Machines
Threading Machines
Slotters
Broaching Machines
Lap and Hone Machines

Most of these groups could again be broken down into standard or production machines; generally speaking, the former are supplied to all classes of machine tool users, whereas the latter are supplied to meet the specialised requirements of those industries engaged on quantity production.

Inevitably some statistics will have to be quoted, but let it be clearly understood that machine tool statistics are more liable to error and misunderstanding than is the case with most other products, due to the fact that the term "machine tool" is, as indicated above, a very elastic one and to the added complication that many machine tools are supplied not as bare machines but with tooling, work-holding fixtures and equipment, the total value of which in some cases will considerably exceed the cost of the bare machine.

It would certainly be helpful in gauging the progress of the machine tool industry if there were any reliable pre-war statistics, but unfortunately they do not exist. The 1935 Census of Production gives a figure of £6,735,000 for that year, which includes the sale of spares and replacements. A figure of 14 million pounds is sometimes quoted as being the output of metal-cutting machine tools in 1938 but this was only an estimate and included spares and replacements.

In considering the production of the industry to-day, it is well to remember that official figures cover only machine tools and equipment sold with them but do not include tooling and equipment sold separately, nor do they include machine tools rebuilt by the manufacturer. From this we may deduce that the total production of the machine tool industry is substantially higher than the official figures, which, for the year 1949, were as follows :—

	£
Metal-cutting machine tools supplied to the Home Market	22,647,000
Metal-cutting machine tools supplied to the Export Market	14,395,000
	£37,042,000

For the same period, metal-cutting machine tools worth £3,339,000 were imported.

The bulk of the output of the industry is probably produced by some fifty of the larger firms but, in addition, there are many small firms and sub-contractors making a very useful contribution. If a list were made of all companies and sub-contractors

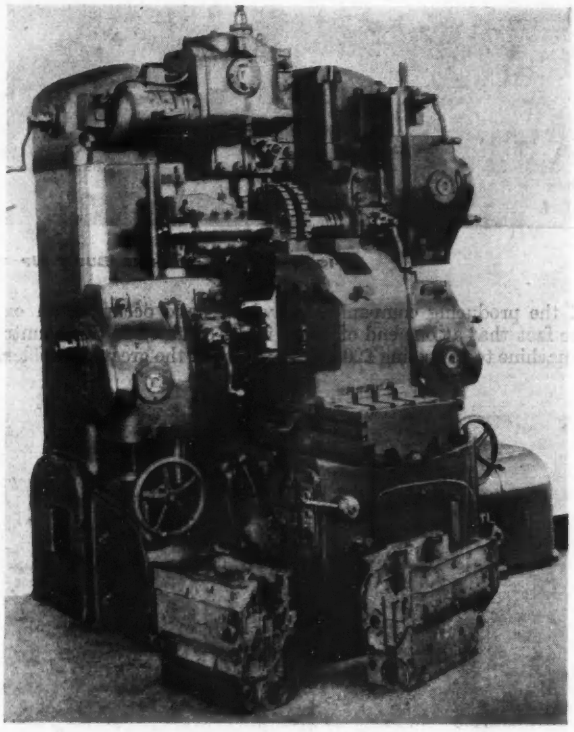


FIG. 1—MILLING MACHINE BUILT UP FROM STANDARD COMPONENTS

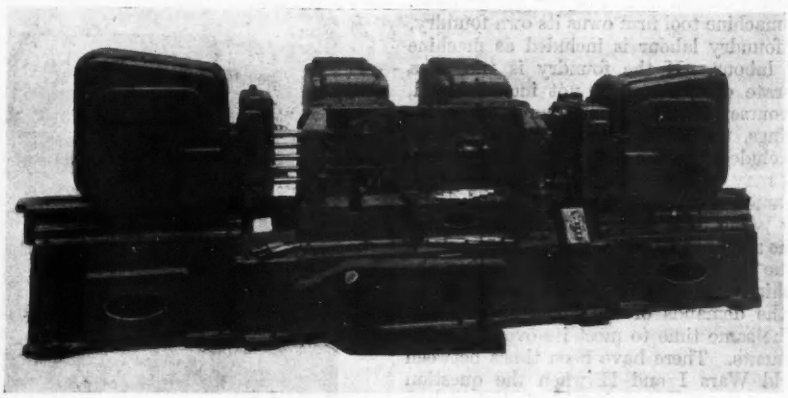


FIG. 2—MULTI-SPINDLE DRILLING MACHINE WITH STANDARD UNIT HEADS

* No. I, "An Introductory Survey," by B. White, appeared February 17th; No. II, "The Threshold of Productivity," by F. A. Martin, March 3rd; No. III, "High Productivity and Production Costs," by Sir Claude Gibb and Gordon M. Baker, March 17th; No. IV, "Standardisation in the Aircraft Industry," by E. C. Bowyer, March 31st; No. V, "Restrictive Practices," by Arthur Woodburn, April 21st; No. VI, "Research for Productivity," by Dr. D. F. Galloway, May 19th; No. VII, "Consequences of Simplification," by W. D. King and H. Sherburn, June 30th; No. VIII, "Works Extensions," by C. K. F. Hague, July 28th and August 4th; No. IX, "Mechanical Handling," by F. Garner and A. Siddall, August 11th and 18th; No. X, "The Importance of the Craftsman," by F. V. Everard, September 1st; No. XI, "Productivity in the Smaller Engineering Works," by Antony Vickers, September 15th; No. XII, "Productivity in Civil Engineering," by Lieut.-Colonel C. M. Norrie, September 29th; No. XIII, "The Measurement of Productivity," by L. H. C. Tippett, October 13th.

† Chairman, Charles Churchill and Co., Ltd.

which produced machine tools, including low-cost machines, the total would be in the neighbourhood of 400.

The discrepancy in the size of machines and the size of the producing companies is indicated by the fact that at one end of the scale you have machine tools costing £20,000, whereas the average price of a low-cost machine is approximately £20.

We are again in difficulties when we consider the official figures of the labour force. If a machine tool firm owns its own foundry, the foundry labour is included as machine tool labour. If the foundry is run as a separate company, it is not included and, of course, if the manufacturer buys his castings, the labour used to produce them is excluded. In the case of sub-contractors, who may produce machines as a side-line, the amount of labour is an estimated figure only. The total labour force is somewhere in the neighbourhood of 40,000.

The question is often asked whether the machine tool industry is adequate to meet all the demands of the home market and at the same time to meet its overseas commitments. There have been times between World Wars I and II when the question was reversed—could British industry buy sufficient machines to keep the machine tool industry alive?—and, indeed, during that period a number of old-established companies were forced out of business. This clearly indicates the wide fluctuations in demand which have occurred, an experience which is not confined to this country.

One of the greatest problems which always confronts the machine tool manufacturer is that of estimating future demand, both as regards quantity and type and size of machine. Since the end of the war, with the dollar shortage and the temporary elimination of the German industry, the pressure on the British machine tool industry has been considerable and it must be remembered that the industry had no great inheritance of wartime expansion. The possibilities of expanding are to-day strictly limited both as regards building and labour and, on the other hand, many firms that had been acting as sub-contractors have resumed their normal business. Under these circumstances the effort made by the industry to meet the requirements of the home and export markets has been a remarkable one. New designs have been introduced and, additionally, many machines from the Government surplus were rebuilt and helped to re-equip the engineering industry for its peace-time production.

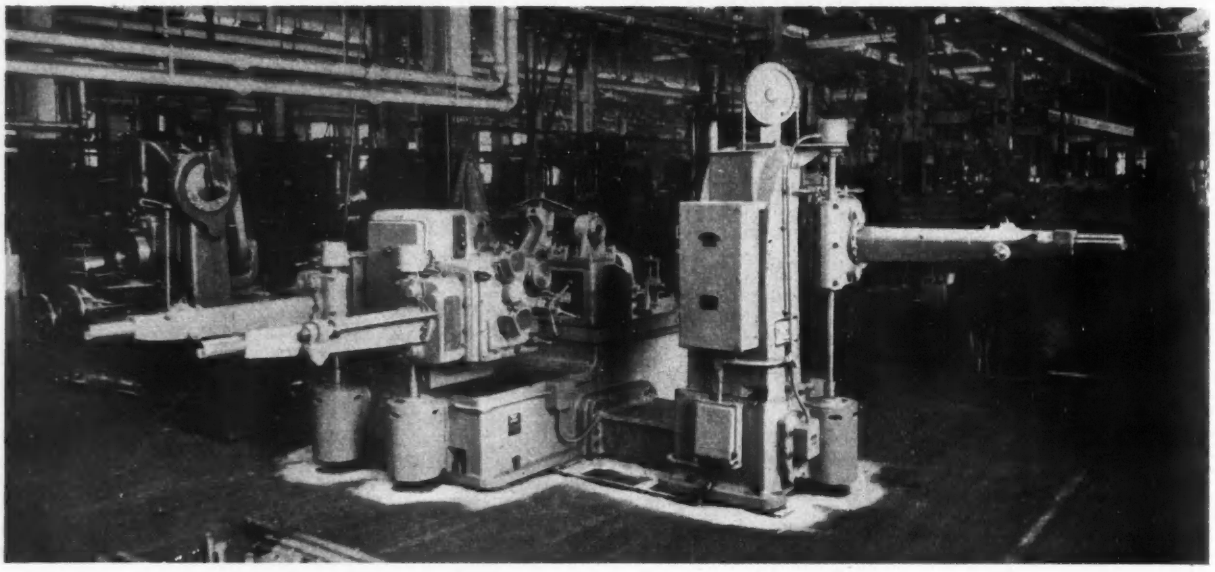


FIG. 3—BORING MACHINE BUILT UP WITH STANDARD HEADS

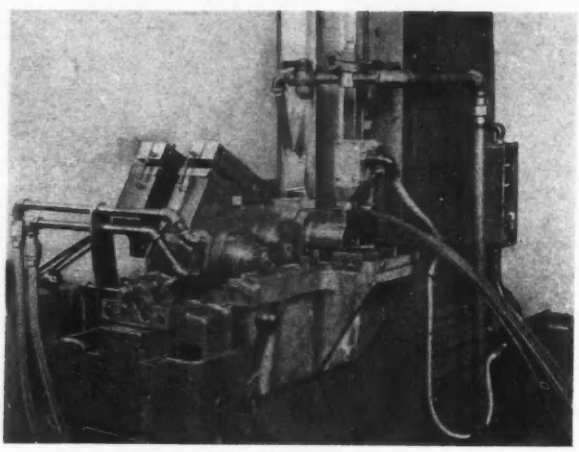


FIG. 4—BROACHING BAND SAW BLADES

STANDARDISATION

It is impossible to-day to discuss production efficiency without the question being asked: "What are you doing to standardise or simplify your product?" The quantity production of standard machines may be the manufacturer's dream but unless they meet the requirements of the user they serve no useful purpose and we find that even the so-called standard machines have to be supplied with different equipment, attachments, electrics and English or metric screws, according to the market or customer requirements.

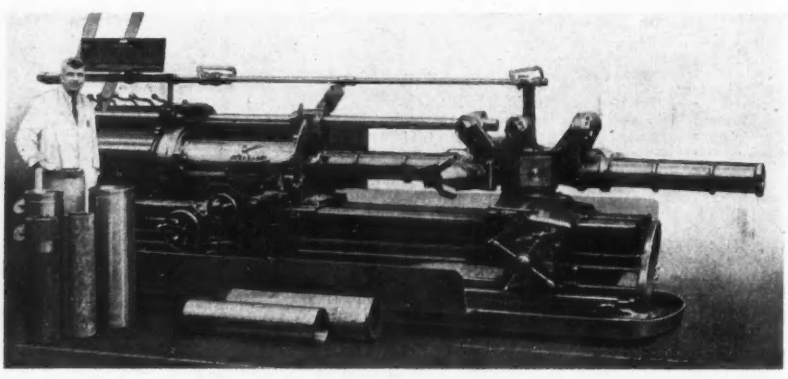


FIG. 5—BORING AND TURNING BRONZE LINER

While any desire or attempt at undue standardisation is defeated by customers' needs, this does not mean that standards have not been adopted for many machine parts and the list of these is growing all the time. Believing that it is better to have a national as opposed to an industry standard, the M.T.T.A. has nominated members who sit on over thirty-five committees of the British Standards Institution. The work of these committees relates not merely to the machine tool and its component parts but also to articles produced on machine tools.

Again, standardisation has been adopted widely as regards machine tool components and sub-assemblies and one finds many production machines which, at first sight, appear to be entirely special but which have in fact been largely built up of standardised components. In this way, the customer gets the advantage of quicker delivery and lower price compared with a machine which would otherwise have to be designed and built from the ground up.

As an example of this, Fig. 1 shows a fixed-bed milling machine built up from standard components for milling the tenon slot, manifold and all side faces of cylinder blocks at the rate of seven blocks per hour. Fig. 2 shows a four-way horizontal multi-spindle drilling machine for machining tractor parts, the drilling heads being standard units. In both cases the work-holding fixtures are special. In Fig. 3 there is seen a three-spindle horizontal boring machine supplied for boring, facing and recessing the two main lines of boring and simultaneously the hinge-pin line on aircraft landing gear. In this case three standard units were used, the bed forming a very rigid jig. Floor-to-floor time was forty minutes, against several hours previously required for the operation.

The difficulties of simplification come into a somewhat similar category. Under war time conditions, it was possible to do something in this direction but the field was very strictly limited.

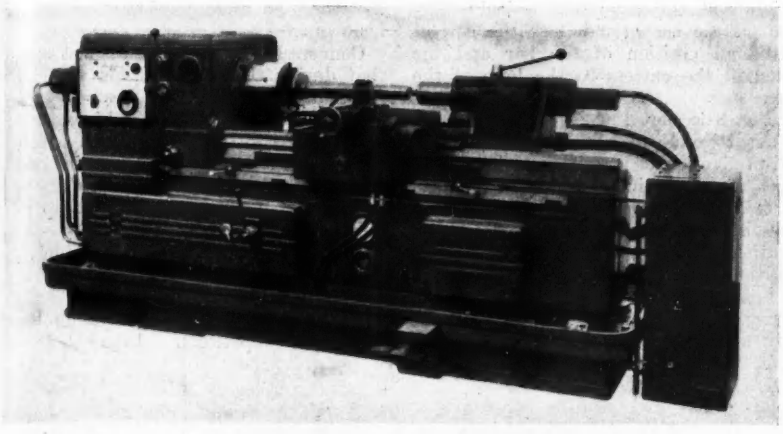
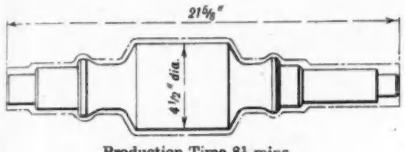


FIG. 6—HYDRAULIC PROFILING LATHE



Production Time 8½ mins.
Material; Casehardening Steel

FIG. 6A—WORM SHAFT MACHINED ON HYDRAULIC PROFILING LATHE

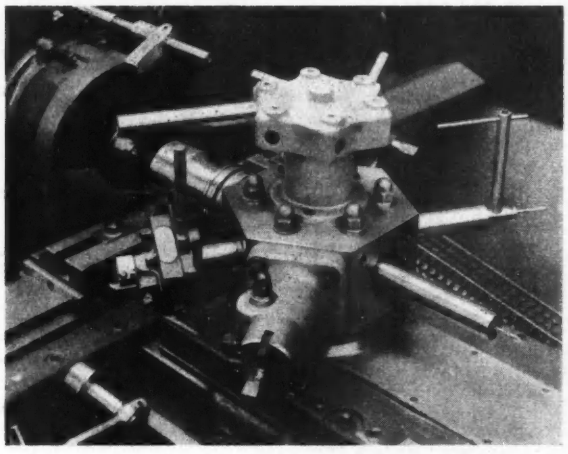


FIG. 8—TOOL LAYOUT ON CAPSTAN

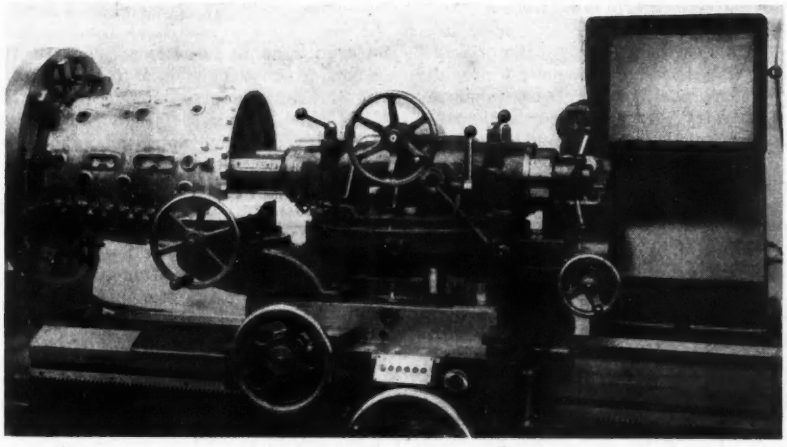


FIG. 7—MACHINING AIRCRAFT COMPRESSOR CASING

PRODUCTION EFFICIENCY

While much may be learnt from the standards of production efficiency in the best machine tool shops, it is of necessity not spectacular and is of a different order to that in the engineering production shops where quantity production is the rule and where we may find machine tools which have paid for themselves in twelve months and where it is possible to show that the wisely selected machine tool forms one of the best buying investments possible. The machine tool manufacturer's task is to meet the exacting demands of industry for machines that will produce with ever-increasing accuracy, will machine the newer alloys and will give greater production per operator. He therefore has to act as production consultant, advising on the application of machines, tooling equipment and methods, in close collaboration with his customer, and then offer the machine for the job and see that it "delivers the goods" and consequently it is often said that the machine tool manufacturer sells production rather than machines. For these reasons the machine tool manufacturer's great contribution to the overall production efficiency of British industry starts in his own shop and in his willing co-operation with his customer,

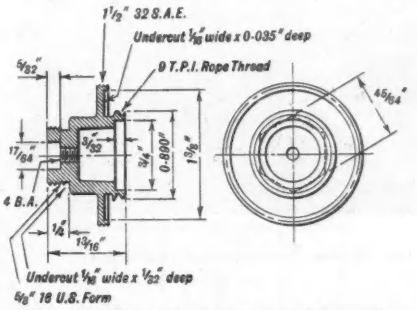


FIG. 8A—WORK SUBJECT FOR CAPSTAN SHOWN IN FIG. 8

but is best seen in the customer's own shop.

While the readers of the technical journals are no doubt well posted on the production possible with modern machine tools, it may not be out of place to give a few

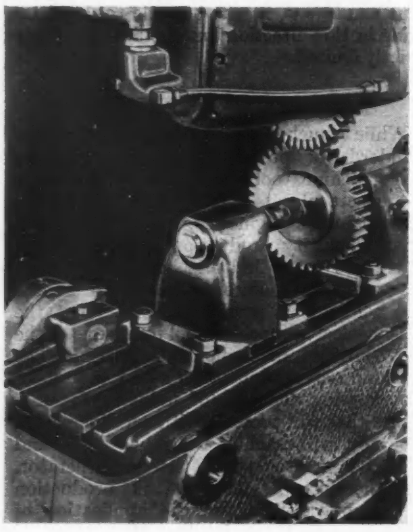


FIG. 9—GEAR SHAVING

examples of the help rendered by the machine tool industry to speed production. Fig. 4 shows the set-up on a 1-ton hydraulic surface broach for broaching teeth in bandsaw blades at the rate of 600ft to 1000ft per hour, depending on the size of bandsaw. Fig. 5 shows a bronze liner, 11¼in bore and 2ft

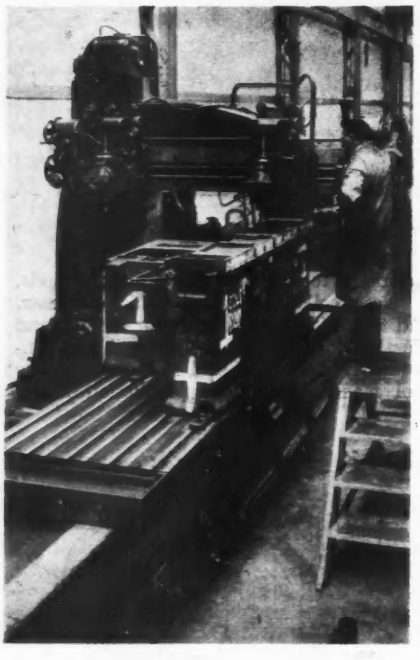


FIG. 10—SLIDEWAY GRINDER

10⅜in long, on a combination turret lathe with lengthened bed. The liner was rough and finish bored and turned within a limit of + or −0·0015in, total time 125 minutes. Fig. 6 shows a semi-automatic hydraulic profiling lathe and Fig. 6A is a typical job done on the machine. Fig. 7 indicates the result of collaboration between two machine tool companies, an optical instrument manufacturer and the user. The work subject is an aircraft compressor casing. The bar to be seen in the engraving is fed into the bore of the casing to the correct position and the saddle is locked. The image on the screen indicates the correct longitudinal position of the bar and the relation of the cutters to the bore of the casing.

In Fig. 8 is shown the tool layout used on a new type of capstan, designed for high-speed production of brass parts. The work subject is shown in Fig. 8A. The total time taken was 35 seconds. Fig. 9 illustrates the gear-shaving process, which has revolutionised the finishing of gears. In the automotive field, for instance, gears are now finished in about two minutes. The slideway grinder shown in Fig. 10 has been widely adopted by machine tool builders, as it not only ensures precise alignment but saves hours previously spent on scraping. In the case illustrated, 23 hours were saved by the use of the slideway grinder. The centreless grinding of bearing needles (Fig. 11) was speeded up from a maximum of 3000 per hour for manual feeding to 25,000 per hour with the centrifugal hopper fitted to the machine illustrated.

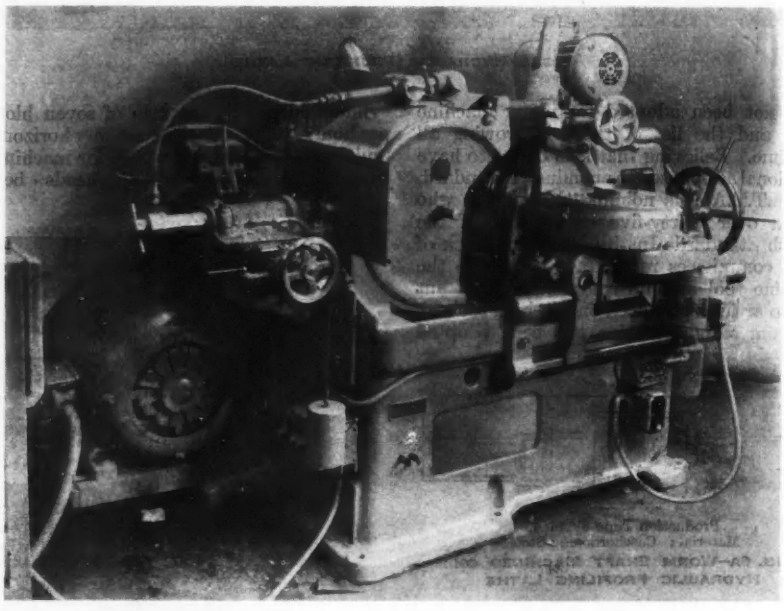


FIG. 11—CENTRIFUGAL FEED HOPPER ON CENTRELESS GRINDER

Production efficiency, like charity, begins at home and with this in mind some eighteen months ago, the Machine Tool Trades Association established six panels in the principal machine tool building centres to promote by any means possible the greater efficiency of the industry. It was never anticipated that any spectacular results would be achieved but it was confidently expected that steady progress would be made, if only by the wider adoption of the mental outlook and the methods which had been developed and found successful by many of the more progressive companies. Apart from this, it was hoped that new ideas might be forthcoming.

VISITING

One of the most productive and well-proved methods for keeping up to date has been that of "visiting." If the "visiting" policy is adopted, it means, of course, that return visits must be expected and welcomed. Experience has shown that it is almost impossible for an intelligent engineer to visit a works engaged in the manufacture of a similar product to his own without his noticing some method, some operation or idea that could be usefully adopted or applied in his own works.

Conversely, the probability is just as strong that during the course of his visit he will notice some things that are not done as efficiently as in his own works and that he will be able to offer suggestions which will be welcomed by his host. This two-way traffic in ideas promotes a healthy atmosphere and a sense of comradeship in the industry.

The Production Efficiency Panels have done good work in furthering this sort of outlook and have had the satisfaction of breaking down the few remaining barriers between competitors. Like their more progressive friends, they have found that it is possible to help a competitor and still remain as keen a competitor as in bygone days when an iron curtain existed between them.

It would not be possible to write an article on the part played by the machine tool industry without referring to the Production Engineering Research Association, as the M.T.T.A. did so much to get this established on a sound basis and substantial support is still given by M.T.T.A. members. While in the early days it may have been an act of faith to support the Research Association, it can, to-day, offer definite proof of its value to any progressive engineering firm, a fact which was made clear by Dr. Galloway, in his article, which appeared in this series on May 19th.

The contribution of the machine tool industry to productivity is absolute in the sense that it was the invention of machine tools which gave the world productivity in the modern understanding of the term. The first use for the machine tool was, of course, the performance of those tasks which were beyond the capacity of the hand tool wielder. This raised the standard of living and, as labour became a more valuable commodity, the machine tool was used to produce more rapidly and efficiently work which could still be done by hand. Until comparatively modern times, however, there per-

sisted even in engineering the theory, which was to some extent justified in practice, that "hand finished" represented the height of quality. Even this theory has been outmoded by the great production industries and wherever the quantity to be produced will justify it, the aim is to finish all components on the machine tool to such fine limits that they can be assembled right away and the finished article produced without the necessity of any final fitting operation. The machine tool is therefore seen to be the master key to productivity and hence to the higher standard of life.

The L.M.S. Mobile Test Plant in Action

By O. S. NOCK, B.Sc., A.M.I.C.E., M.I.Mech.E.

THE gradual evolution of a truly scientific method of conducting road tests on steam locomotives has been spread over more than fifty years. From early indicator trials, such as those of W. M. Smith on the North-Eastern Railway in 1898, on which THE ENGINEER commented so outspokenly, to the mobile testing plant devised by the research department of the former London Midland and Scottish Railway, is a long and sometimes roundabout road; and when the time came for this latest remarkable modern plant to be put into service, and its unique features were described by Dr. H. I. Andrews in a paper read before the Institution of Mechanical Engineers in April, 1948, there were, to judge from the discussion upon that paper, some who felt then that there was little advantage to be gained by a perpetuation of the practice of road testing, when such magnificent modern laboratory facilities would shortly be available in the new stationary testing plant at Rugby. It is not the purpose of the present article, however, to enter into discussion upon the relative merits of stationary and road testing—road testing, that is, under the constant-speed conditions made possible by the L.M.S. mobile testing plant. Each has its own vital part to play in the development of British locomotive practice. The mobile testing plant is being used at the moment to assess the overall road performance of certain locomotives in varying conditions of operation and with different grades of fuel.

FIG. 1—ENGINE NO. 35005 WITH MOBILE TEST PLANT AT CLAPHAM JUNCTION

By the courtesy of Mr. R. A. Riddles, member of the Railway Executive responsible for mechanical and electrical engineering, I was privileged to travel on the plant during some trials on the Southern Region between London and Salisbury. The particular test witnessed was one of a series carried out on the "Merchant Navy" class "Pacific" engine No. 35005, "Canadian Pacific," which had been fitted experimentally with a mechanical stoker. One can, of course, appreciate the extreme interest attaching to the results of such a series of trials; at the moment, however, I am concerned, not with the particular locomotive under test nor with any discussion of possible results, but rather with the actual practice of testing as conducted in the mobile plant. About the principle of road testing at constant speed I will add only that one can secure many of the advantages of stationary plant testing, with the advantage that there is no need to attempt to reproduce in a laboratory the aerodynamic conditions arising from the passage of the locomotive through the atmosphere, as has been done in some stationary plants. On a road test there is the complication of wind resistance; but apparatus is available for taking continuous records of relative wind speed and its direction throughout any particular run, and from such records, and the results of researches into the air resistance of trains, the effect of wind upon the train can be assessed.

In the trials carried out between London and Salisbury the constant speed stipulated was 50 m.p.h., and with the co-operation of the traffic department a path was arranged, following the Atlantic Coast Express, whereby an unchecked run during the constant-speed period was secured. The traffic arrangements were interesting, as showing how the work of the mobile testing plant is dovetailed into

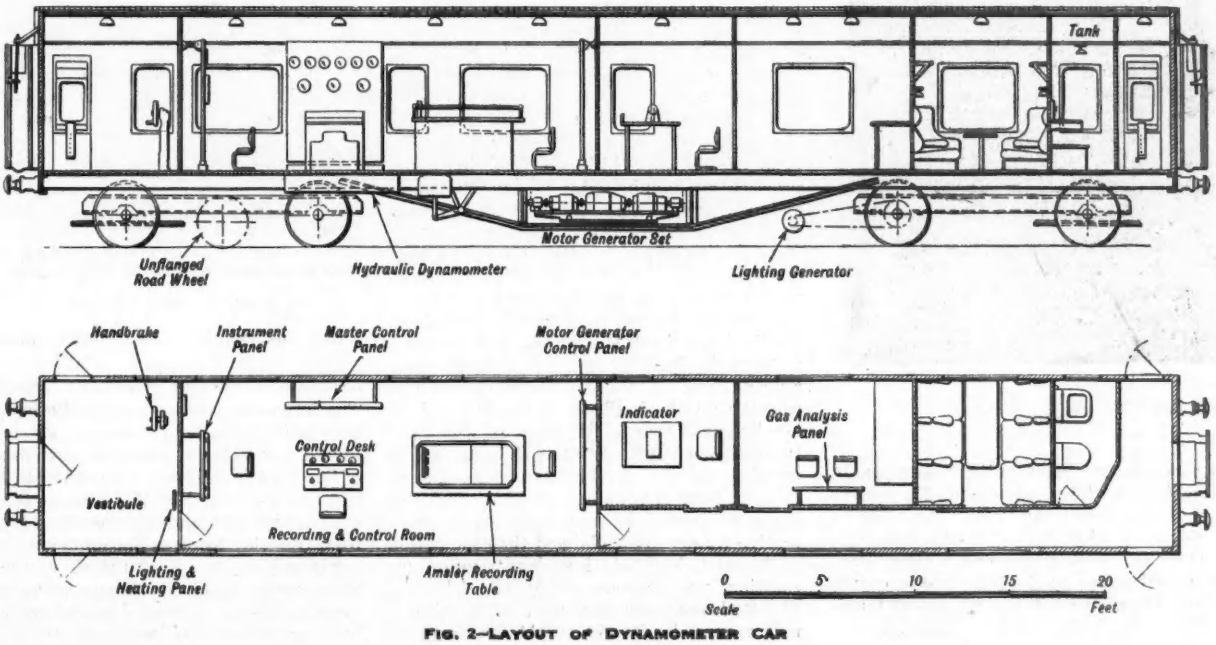


FIG. 2—LAYOUT OF DYNAMOMETER CAR

the ordinary service at midweek. The train left from one of the Windsor line platforms at Clapham Junction, followed the "Riverside" line as far as Point Pleasant Junction, and from there took the spur to the line from Putney Bridge to Wimbledon, which is used jointly by trains of Southern Region and London Transport Executive. The constant-speed test on the outward run extended roughly from Esher to Andover, a distance of 52 miles. Beyond the latter station a reduction of speed had to be made for permanent way work in progress; after the restricted length had been passed over the remainder of the distance to Salisbury was used for the carrying out of certain indicator trials at speeds other than 50 m.p.h. Similarly, on the return journey the Salisbury-Andover stretch was again used for indicating and a constant-speed test followed. Since the original description of the plant the new dynamometer car has been completed, and on the journeys in question the "train" consisted of this car and two of the mobile testing units. On the day I travelled the weather was fine and calm, though I understand that throughout these particular trials no continuous measurements of relative wind speed and direction were taken. The engraving Fig. 1 shows the locomotive and test plant about to leave Clapham Junction.

The layout of the dynamometer car is shown in Fig. 2.* Although a system of telephones extends throughout the plant and the engineer at the control desk can at any time converse with "key" members of the testing staff, it is convenient to have the instrument panel and the Amsler recording table adjacent to the control desk, since the test as a whole depends upon the functions of these three units. On the instrument panel is shown the data concerning the steaming of the locomotive: boiler, steam chest and exhaust pressure; steam temperatures in the boiler, leaving the superheater, and exhaust; while temperatures of the products

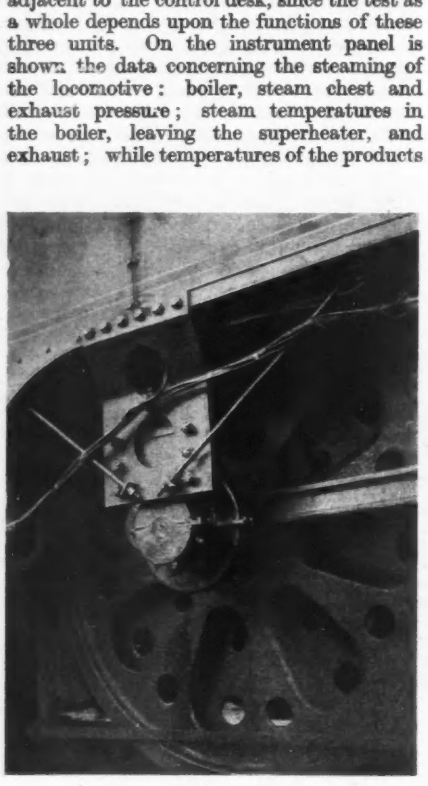


FIG. 3—SELSYN UNIT ON REAR COUPLED WHEEL

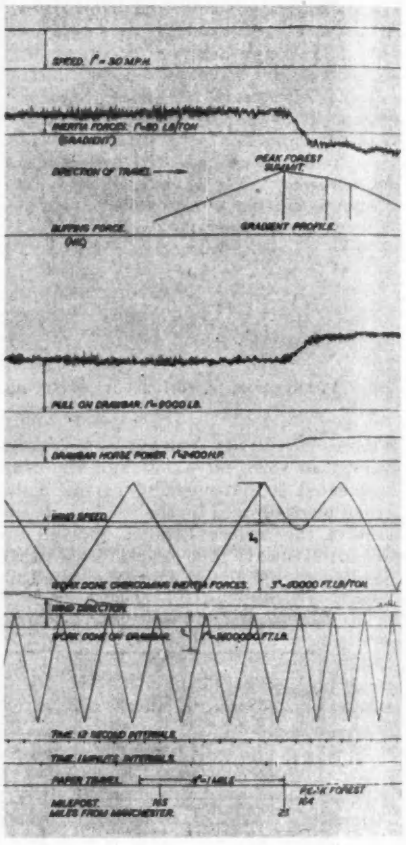
of combustion are taken in the firebox and in the smokebox. The instruments themselves are of the non-recording type. The observer at this panel, while noting the various temperatures and pressures, keeps in close touch with the observer on the footplate to ensure that the stipulated test conditions are maintained. On this particular run a constant steam chest pressure of 200 lb per square inch was required, in conjunction with 20 per cent cut-off on the outward run and 30 per cent on the return. The behaviour of the locomotive on coal of very inferior quality was being examined, and the stipulated steam chest pressure of 200 lb per square inch was no doubt chosen to admit of a constant value

FIG. 4—CYLINDER WITH PNEUMATIC BALANCING UNIT

being maintained in the face of probable fluctuations in boiler pressure, due to the fuel, below the rated maximum of 280 lb per square inch.

The maintenance of a constant indicated horsepower throughout the test is essential, and particular care is taken in the measurement of this quantity. The older method of fitting ordinary steam indicators adjacent to the cylinders and the taking of diagrams by observers riding in a specially constructed shelter on the front of the locomotive obviously had its own disadvantages, quite apart from the chances of error inherent in the method itself, and the practical impossibility of erecting shelters at the front end of streamlined or air-smoothed locomotives. In the mobile testing plant a Dobbie-McInnes Farnborough (Royal Aircraft Establishment) type of indicator is used, in which the drum is continuously revolving in exact synchronism with the revolving of the locomotive driving wheels; thus the errors due to inertia that are inherent in the oscillating type of indicator hitherto used in steam practice are eliminated. It will be appreciated, however, that the diagram is drawn on a base representing the crank angle, instead of the piston stroke, as in the oscillating type of indicator. The attachments to the locomotive, though requiring very accurate pre-adjustment, are simple in themselves. The indicator itself is mounted in a compartment of the dynamometer car, and the exact reproduction of the speed of crank axle rotation on the indicator drum is obtained by the use of two Selsyn units, of which the transmitting unit on the locomotive is coupled to the driving axle through an Oldham flexible coupling, to compensate for the movement of the axle relative to the locomotive frame. It is claimed that the action of the two Selsyn units is such as to reproduce rotation with an accuracy of ± 1 deg. Fig. 3 shows a close-up view of the Selsyn unit mounted adjacent to the rear coupled wheel of the "Merchant Navy" class locomotive on test. The Selsyn itself, and the flexible coupling and drive mechanism, are housed in a specially constructed case, which can be readily fitted up on any engine.

The pressure component of the indicator diagram is recorded by means of a pneumatic balancing unit, one of which is fitted to each end of all cylinders of the locomotive, as shown in Fig. 4. A balancing air pressure, which can be pre-set and maintained at any value within the range of pressure likely to be reached in the cylinders of a steam locomotive, is conveyed to the cylinder elements by piping. When the steam pressure in the cylinder reaches the same value as this pre-set air pressure a contact is made that pinpoints the pressure on the indicator diagram. The operator in charge of indicating varies the air pressure—in the particular example under review from atmosphere to 200 lb per square inch—and gradually the complete indicator diagram can be traced out. The process of obtaining such a diagram usually takes about six minutes, and as it represents the working over an appreciable time there is a considerable "scatter" of the points on the expansion and compression lines due to



Note increases in drawbar pull and drawbar horsepower as train passed Peak Forest and gradient changed from 1 in 90 up to 1 227 down.

FIG. 5—CONSTANT SPEED TEST RECORD

variation in pressure from stroke to stroke. The importance of the mobile testing plant, in being able to hold the speed at some required test value, was shown on the sections of line west of Andover. The constant-speed test was completed by this time on the westbound run, and although the line descends from Grateley towards Salisbury on steepening gradients, this final stretch was used to take some indicator diagrams at slower speeds. Near Porton, for example, the braking units were loaded up to hold the

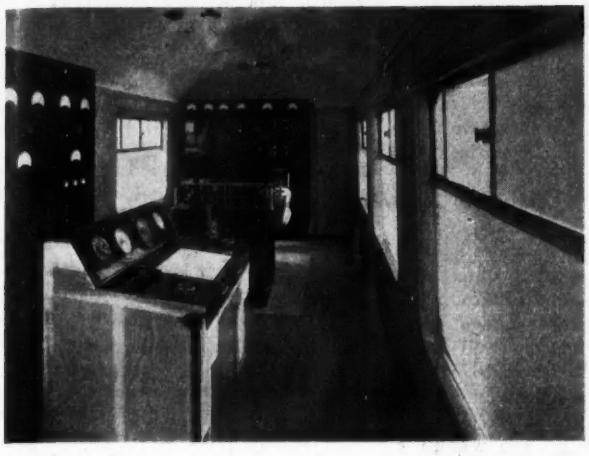
* Fig. 2 taken from I.Mech.E. proceedings.

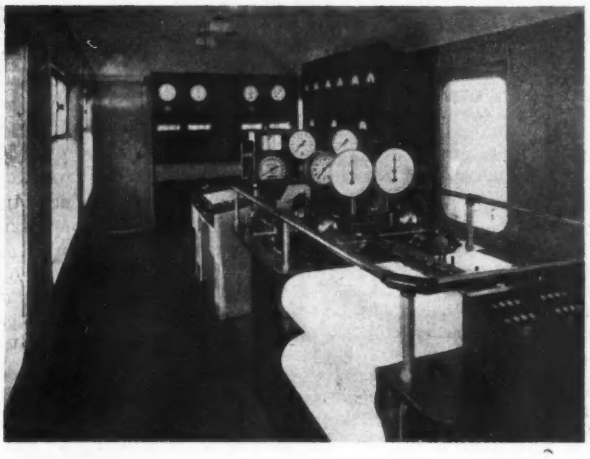
engine at no more than 20 m.p.h., on a gradient of 1 in 169 down, while cards were taken at 15 per cent cut-off, and the usual 200 lb per square inch steam chest pressure.

On indicator trials run in former days the downhill sections of line were of little value; on stretches like those from Peak Forest down to Rowsley, or Blea Moor down to Settle Junction, to mention two well-known gradients on the Midland line, the locomotives under test would be working under very light steam, if not actually coasting. But with the mobile testing plant full use can be made of almost every mile of the line. On the trip I accompanied indicator diagrams were still being taken as we approached Tunnel Junction, only a mile short of Salisbury, and I understand that on one of the up journeys some diagrams at moderate speed were taken between Wimbledon and East Putney. Naturally, in such cases of deliberately slow running care has to be taken to avoid causing delays to following trains, and on the westbound trip after Grateley the genial old Southern Region guard was called into consultation by the senior members of the testing staff to confirm that the "road was ours" sufficiently long to make the records desired.

The taking of indicator diagrams at precisely maintained road speeds is, however, only one outcome of the central feature of the mobile test plant—the electrical braking units and the method of automatically controlling the speed. The principles involved were described in complete detail in Dr. Andrews's paper read before the Institution of Mechanical Engineers in April, 1948, and reported in THE ENGINEER, April 23, 30 and May 7, 1948. In actual practice it was fascinating to watch the precise manner in which the engineer at the control desk was able to build up to the stipulated test conditions, working, of course, in close collaboration with the observer on the footplate. As the steam chest pressure was increased so, by hand control, was the excitation current on the mobile test unit braking generators increased by adjusting the "hand control" potentiometer to regulate the feed to the grid-controlled rectifiers, which in turn supply direct current to the field windings of the exciting generators. While the change-over switch remains in the "hand control" position the second potentiometer, for automatic control, is adjusted until the voltage from an independent fixed reference supply is approximately equal to the voltage from the tachometer generator driven off the unflanged road wheel of the dynamometer car. This latter voltage, which is kept at a constant value by two stabilisers, is, under automatic control, opposed by the voltage of the tachometer generator, and the difference in potential between the two is utilised to increase or decrease the excitation current in the brake generators. To obtain high sensitivity, the voltage representing the error between the specified test speed and the actual is amplified; but it is equally necessary to reduce that sensitivity to a minimum when switching over from hand to automatic control. The facility of increasing or decreasing the sensitivity is provided by a third potentiometer, which at the time of switching over from hand to automatic control is placed in the position of least sensitivity, so as to reduce to a minimum any surge or wheel slip arising from a difference between specified and actual speed that could scarcely be detected from the relative voltmeters on the master control panel. As an actual example of working up to required test conditions, on the eastbound journey we left Andover Station, where a stop had been made to take water, at 4.20½ p.m.; the switch-over to automatic control took place at 4.28 p.m., by which time locomotive working had been stabilised at 50 m.p.h., 30 per cent cut-off and 200 lb per square inch steam chest pressure. The draw-bar pull, acceleration and gradient are directly recorded, but through a system of spherical integrators the speed, draw-bar horsepower, work done on the draw-bar and also against acceleration and gradient are recorded graphically on the chart. Facilities are also provided on the table for recording continuously the relative wind velocity and the relative wind direction, though these quantities were not measured in the trials conducted on the Southern Region engine No. 35005.

The rapid response of the automatic control to changes in conditions could be seen on the master control panel in the exciting currents fed to the mobile test unit brake generators, and in the variation of draw-bar horsepower. Changes in gradient are fairly frequent during this run, and usually the corresponding change in draw-bar horsepower was complete in about five seconds. In Fig. 5 is reproduced a typical extract from a dynamometer record.





FIGS. 6 AND 7—CONTROL AND RECORDING ROOM

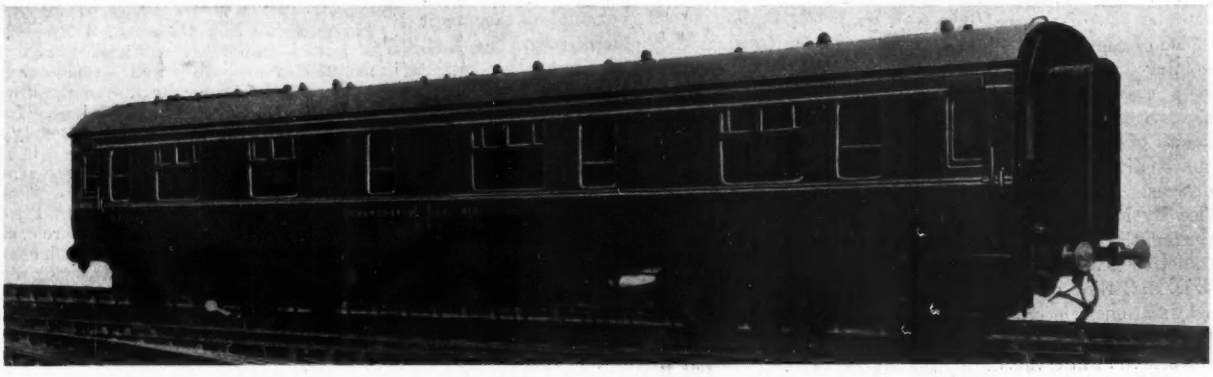


FIG. 8—DYNAMOMETER CAR

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NOTICE TO READERS

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No undertaking can be given to return drawings or manuscripts; correspondents are therefore requested to keep copies.

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PRINTING DIFFICULTIES

We regret that owing to the continuance of the dispute in the printing trade this issue has to be an "emergency" number heavily reduced below the normal size.

BRITISH LOCOMOTIVE TESTING

THE 1950–1 session of the Institution of Locomotive Engineers, which opened with the inauguration of Mr. R. A. Riddles as President, on Wednesday, September 20th, promises to be one of unusual interest. The high office of the President himself, and the forthcoming appearance of the first British Railways standard locomotives, naturally invests current proceedings of the Institution with an air of expectancy as to what may or may not be divulged about the origins of the new designs. Any doubts on this score were dispelled by Mr. Riddles's own remarks in introducing the first paper of the session, "Locomotive Testing on British Railways," by Mr. D. R. Carling, superintending engineer of Rugby stationary locomotive testing plant. Mr. Riddles explained that the various papers to be presented at intervals during the winter would together form a comprehensive picture of the development work on which the departments for which he is responsible are engaged. It was appropriate, he said, that research and testing should come first. Other subjects following were "Electric Traction Prospects for British Railways," "Standardisation of Coaching Stock," "Modernisation of a Large Motive Power Depot," "British Standard Locomotives," and the "Practice and Trend in Development of Diesel Engines." Mr. Carling's paper, after describing the various items of test equipment which British Railways have inherited from the four constituent companies, went on to define "proper testing," as he termed it, as the foundation upon which sound standards can be built, both of design and performance. In this he was referring, not to standardisation generally, but to the establishment of reliable criteria, against which design proportions or the performance of locomotives can be set for comparison. Above all, he stressed the importance of interpreting test results so that the scheduling of trains can be determined on a scientific basis.

In the general scheme of things on British Railways, in progress now and as envisaged in the near future, the dynamometer car, the mobile test plant and the testing stations at Swindon and Rugby will all play their several parts. In amplifying this point Mr. Carling quoted some interesting examples of work undertaken since the nationalisation of the railways to show how each form of testing was being utilised effectively. In 1947 a new design of lightweight 2–6–0 was brought out on the L.M.S.R. This engine proved successful on the work for which it was designed, but when examined with a view to adoption on Western Region branch duties certain shortcomings were revealed. The requirements were admittedly more severe than those for which the design had originally been prepared; the engine was required to steam on either soft or hard coal, and to work heavier loads on the steepest gradients. The first set of trials with the former Great Western dynamometer car showed inadequate performance. The engine was thereafter put on to the Swindon stationary testing plant, and from these observations the Western Region locomotive drawing-office devised certain inexpensive modifications to the front end, the efficacy of which were duly examined on the Swindon stationary testing plant. As a result not only was the engine's distaste for soft Welsh coal overcome, but the boiler performance was so enhanced as to permit of an increase in cylinder diameter, with consequently increased tractive effort. By way of contrast Mr. Carling quoted an example of the practical use to which data obtained with the L.M.S. mobile test plant can be put. In a series of trials over the route Derby, Leicester, Rugby, Willesden, characteristic curves were determined for the Stanier Class "5" mixed-traffic 4–6–0, including the relationship of speed and draw-bar pull, in the first case for the maximum output from the boiler, and in the second for the condition of maximum efficiency. From such characteristic curves the timing of a train of any chosen weight can be determined over any route for maximum continuous output from the boiler or for maximum thermal efficiency.

One of the two examples of this kind quoted by Mr. Carling is arresting, to say the least of it. During the locomotive interchange trials of 1948 one of these Class "5," 4–6–0s ran a 334-ton train from St. Pancras to Manchester, on a schedule including six stops, in 4 h. 22 min. Calculations from the characteristic curves determined with the mobile test plant revealed that for maximum economy the run should have been made in 22 min. less time. This was not merely a case of securing an improved rate of coal per d.h.p.-hour, but a clear saving of 576 lb in deadweight of coal. Judging by the frequency with which some trains within our knowledge regularly finish their journeys ahead of time, the margin of engine power must be considerable, and we hope that the prospect of saving coal through running faster on certain duties will not be lost upon those responsible for timetables. We realise, however, only too well, that the thermodynamic ideal is not the only factor to be taken into account in the planning of train schedules; traffic occupation of the line, condition and alignment of the track, quality of fuel and condition of locomotives, all have to be considered. In this connection it is interesting to learn from Mr. Carling's paper that a supplementary set of locomotive characteristic curves are to be established relating to locomotives in the most run-down condition in which they would normally be accepted for work. There seems, indeed, ample evidence now that locomotive testing on British Railways has not merely entered upon a phase far more scientific than generally practised hitherto, but that it is also wholly realistic. With testing equipment that, as several speakers in the discussion on Mr. Carling's paper emphasised, is unquestionably the finest in the world the prospect is encouraging.

The 35th International Motor Exhibition

THE 35th International Motor Exhibition arranged by the Society of Motor Manufacturers and Traders, Ltd. for the motor industry of Great Britain was opened at noon on Wednesday, October 18th, by H.R.H. Princess Margaret at Earls Court. The exhibition hall has been arranged this year to house the stands of more than 520 exhibitors who have been divided into seven main sections, namely, cars, carriage work, accessories and components, tyres, motor boats, transport service equipment, and the caravan and light trailer section. A number of entirely new models are exhibited in most sections and improved designs are apparent elsewhere. In the car section there are altogether almost 400 models on show belonging to 32 British, 12 American and Canadian, 8 French, and 3 Italian exhibitors. British marine craft manufacturers are well represented a wide range of motor boats and small sailing craft, the latter up to 18ft long. In the caravan section are displayed the latest types of mobile living accommodation which in many cases are luxuriously finished. In stressing the significance of the exhibition on the sustained dollar export drive, Mr. W. Lyons, President of the Society of Motor Manufacturers, stated that from January to August British car shipments, alone, to the U.S.A. and Canada realised 54½ million dollars which almost equalled the combined dollar equivalent recorded against the exports of whisky, cotton yarn and manufactures and pottery.

STREET PARKING IN LONDON AREA.—A full list of the 683 parking places on the highway in the London Traffic Area has been made available, in easy reference form, by the publication of the London Traffic (Parking Places) Consolidation Regulations, 1950, made by the Minister of Transport. The new Regulations, which do not increase the number of street parking places already authorised, consolidate sixteen previous Regulations, made over a period of ten years. Parking places in streets of 91 local authorities are listed. The schedule to the Regulations containing the list is arranged so that local authorities of the same status are grouped together in alphabetical order. Parking places in each area are also listed alphabetically, and there is an indication of the types of vehicle permitted to use them. The Regulations are obtainable from H. M. Stationery Office, price 1s.

Literature

Scavenging of Two-Stroke Cycle Diesel Engines. By PAUL H. SCHWEITZER. London: Macmillan and Co., Ltd., St. Martin's Street, W.C.2. Price 55s.

THIS book deals with the vastly complicated processes of exhausting, scavenging and charging of two-stroke diesel engines. It is a welcome addition to this subject, and especially as English literature thereon is sparse. The author gets straight down to his subject with a delightful economy of words and direct plain language; his clear thinking and powers of lucid explanation make the book a pleasure for the engineer to read.

The book is full of facts of all kinds. It is practical. There is plenty of theoretical work, but it is presented in the most understandable manner possible in relation to the complication of the subject. As an increasing interest is being taken in manufacturing countries all over the world in two-stroke engines, it is opportune that such a book should appear. Naturally, whilst roving over the Western hemisphere, it has mainly an American background and is based upon Professor Schweitzer's wide experience in that country, both in industry and academic life. In the U.S.A. the output of two-stroke diesel engines exceeds that of the four-stroke type, whereas in this country the four-stroke engine predominates at the present time. Nevertheless, there are one or two makers in this country who have done much work on the two-stroke engine, and similar remarks hold good for several other countries. Perhaps, naturally, British engineers might question the historical emphasis which the author gives from time to time. However, it is noteworthy that Professor Schweitzer reserves his most generous praise for work done in this country.

The book compares diesel and "gasoline" engines, then goes on to deal with the peculiarities of two-stroke cycle engines. There follows treatment of such matters as perfect scavenging, perfect mixing and so forth. Next there is an investigation into the effect of scavenging on brake mean effective pressure. There is an interesting section dealing with scavenging arrangements, such as cross-scavenging, loop-scavenging and uniflow scavenging. It is followed by work on porting, including some useful practical hints on avoiding piston ring breakage and an interesting description of Gothic-shaped ports, which the author favours. Inlet ports are next discussed, including such matters as choice of air delivery ratio, selection of scavenge air pressure, and so forth, in different types of two-stroke engines Such matters as exhaust port lead, supercharge and effect of speed and load are analysed. Later on, the various types of scavenge pumps, such as reciprocating, Roots, vane and centrifugal types, are dealt with. There is some good work on exhaust systems and the tuning thereof. Some attention is devoted to the Kadenacy system. Complete calculations for porting follow, and a section is devoted to high supercharging of two-stroke cycle engines. An interesting and useful section deals with experimental investigations of scavenging and the author's work on the tracer gas method, by the use of methylamine, represents a thought-provoking and excellent piece of work. A number of practical hints and tips follow, and then there is an interesting and descriptive section dealing with certain types of engine in production and their main component parts.

In his treatment of the Kadenacy effect, Professor Schweitzer on the whole inclines somewhat more to the original explanations of Kadenacy than most engineers in this country, though with obviously an impartial and somewhat detached attitude. For instance, he refers to the inertia effect of the outgoing gases producing a depression in the engine cylinder, whereas arising from work done in this country, notably by Professor Mucklow, the explanation of wave action and reflected pulses would be preferred. In this connection it is worth noting perhaps that Professor Mucklow's latest work, as revealed in his recent joint paper with Mr. Bannister before the Institution of Mechanical Engineers, does not appear in the ample bibliography in the back of the book.

In one part of the book it is stated "The latest arrival in the two-stroke engine is the uni-flow," and later, "The first two-stroke cycle engines had inlet valves in the cylinder head." It is historically correct, we think, that the uni-flow with poppet valves in the cylinder head was superseded by the port-controlled loop-scavenge engine, and that the latest poppet valve uni-flow is a rejuvenation of the original type. A mild criticism is that there are a number of such contradictions or semi-contradictions in the book. But none of them concern matters of prime importance. In some cases this fault arises from the clear direct statements of the author—far preferable to wrapping up everything in a maze of qualifications and verbiage. This same sort of thing, however, arises also in slightly different ways. For instance, through most of the book where reference is made to the loop-scavenge type of engine, it is assumed that non-return valves are not fitted to the air ports. Certain limited sections of the book do deal satisfactorily with this subject, but time and time again this two-stroke engine, without such automatic valves, is taken as typical of the loop-scavenge type, with consequent rather misleading generalisations to its disadvantage, especially for engineers in this country who are accustomed to looking upon this type as the modern version. There is no disadvantage in all this to the (few) knowledgeable readers of this subject, but it may be misleading to the general reader and student.

In reference to the uni-flow scavenge engine of the sleeve valve type, reference is made to lubrication being a problem. Whilst it is true that the sleeve does present certain formidable problems, such as seizure under certain conditions, this statement, without qualification, may be a little misleading. One of the best features of the sleeve is that it provides excellent piston and cylinder lubrication, as there is always relative motion between the sleeve and the piston rings. The important point is that this applies even at top dead centre of the piston, and, as Ricardo in this country has shown, it leads to exceptionally favourable conditions of lubrication and absence of the usual type and extent of cylinder liner wear.

Naturally, in view of American achievements, the uni-flow type of engine is fully covered in this book, and the author states that uni-flow scavenging is inherently more efficient than other types. Indeed, he refers to it as being nearly perfect. But the work done by Dale in this country does show that uni-flow scavenge can be very inefficient and that a good deal of painstaking design and development work is necessary in order to attain a good scavenge efficiency. This is, of course, true of any system of scavenging and there is probably not much to choose, from the point of view of scavenging efficiency, between uniflow or port-controlled loop-scavenge when each is fully developed and all the numerous relevant factors are fully taken into account. An interesting sidelight on this subject is that it is brought out that even perfect mixing of the incoming scavenge air with the exhaust gases in the cylinders produces not a bad condition, i.e., reasonably good scavenging.

A good deal of study of the nomenclature, definitions and concepts is required in order that the reader may familiarise himself with them. This is necessary before they can become fully useful to him. For example, there are, amongst others, such terms as Charging Efficiency, Purity, Scavenge Efficiency, Trapping Efficiency, Excess Air Factor, Relative Cylinder Charge, Delivery Ratio, Pure Air Ratio, Scavenge Ratio, Scavenge Factor, &c. The book is exceptionally well arranged in this matter, including a fold-out at the back of the book so that the reader can have all the definitions before him on one sheet whilst studying the book. This is but one example of the care and thought which has gone into the making of this book.

There is a section dealing with geared centrifugal blowers, in which it is stated that air delivery is directly proportional to engine speed and that therefore the centrifugal blower is well suited to the scavenging of all two-stroke engines, including the variable-speed type. The treatment given is probably an over-simplification and at best is only approximately true over a limited speed range. It would be truer to say that at constant air delivery ratio the required gear ratio of a centrifugal blower varies hyperbolically with engine speed. In practice designers of two-stroke engines have found that, whilst there is a good deal to be said in favour of the centrifugal blower for the scavenging of constant-speed engines, there are a number of snags in respect of, for instance, variable-speed locomotive engines, and serious snags in connection with variable-speed marine propulsion engines which operate over a wider speed range. Whilst the problem is not insoluble, the disadvantages met with, owing to the fall away of delivery of air by the blower at low engine speeds, are such as to make most designers prefer positive displacement types of scavenge pumps.

This book is almost certainly the best work which has so far been produced anywhere on its subject and will be found useful to designers, to those who have a general interest in this subject and to students.

SHORT NOTICES

The Design of Flat Plates. By C. C. Pounder. The Association of Engineering and Ship-Building Draughtsmen, 96, St. George's Square, London, S.W.1. Price 2s.—The difficulties which surround the design of ribbed and unribbed flat surfaces originally caused the author to formulate a rational system of calculation and design, this was published in 1919, and the fourth edition of this valuable pamphlet has just been published with a revised text. In a foreword, the author mentions that flat plates are divided into two groups, namely those simply supported and encastré and that each group contains a number of variations of the main form, including the use of ribbing. The differential equation for the contour of a deflected thin plate can be applied to practical

designs and solutions exist for circular and elliptical plates for different edge conditions and loading. The problem of the rectangular plate has yet to be solved, and the pamphlet presents rational treatment for several forms of flat plate. In sections I to VI, expressions are developed for rectangular plates having two boundary conditions of uniform thickness and ribbed design, and also of box section. Similarly, plates of circular shape are considered in subsequent sections with an additional section dealing, particularly, with flanged circular plates which cannot be regarded as simple flat plates. In his general notes, the author gives guidance to the correct estimation of fixity of plate edges and discusses fractures. Ribbing and dishing as methods of obtaining additional strength are touched upon, and ribbing, it is advised, should be designed to take a compressive stress. Allowable working stresses of materials are well known, but it is of importance in design that the nature of the loading be accurately assessed. In the final chapter, the experimental work of a number of investigators is reviewed and there is a summary of Flat Plate Formulæ and tables of constants for the rapid evaluation of stresses.

Hydro-Electric Handbook. Second Edition. By W. P. Creager and J. D. Justin. London: Chapman and Hall, Ltd., 37, Essex Street, W.C.2. Price 100s.—This book of reference is of American origin, and was first published in 1926. Owing to the enormous progress of the art of hydro-electric engineering, however, the authors have found it necessary to rewrite most of the text of the first edition, in order to comply with their aim of providing a compendium of all phases of modern hydro-electric development. This wide field of knowledge has been covered in about 1150 pages, with the help of numerous diagrams and charts. As might be expected, these charts together with the examples given in the text are mainly American in origin. The authors state that although a complete exposition of designing methods cannot be contained in the book, sufficient information is presented to give the reader an accurate picture of the problems involved, and to provide sufficient data for preliminary designs, estimates of costs, and reports.

BOOKS RECEIVED

Electric Fuses. By H. W. Baxter. London: Edward Arnold and Co., 41, Maddox Street, W.1. Price 21s.

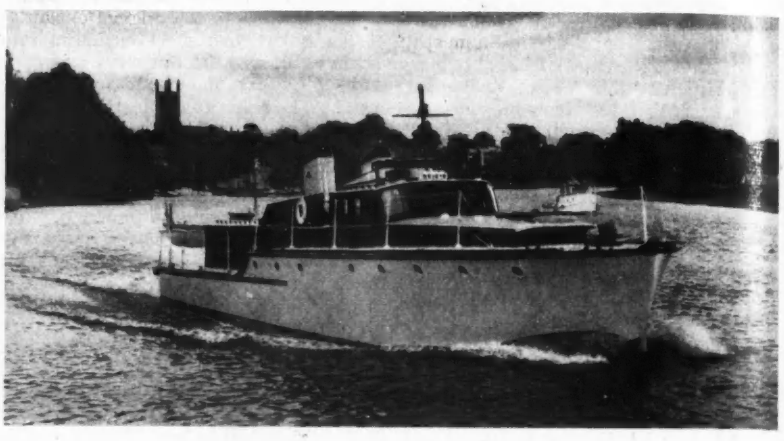
Direct-Current Motor Manual. By H. S. Dusenbery. London: Macmillan and Co., Ltd., St. Martin's Street, W.C.2. Price 26s.

Applied Electricity. By Edward Hughes. London: Longmans, Green and Co., Ltd., 6 and 7, Clifford Street, W.1. Price 10s. 6d.

Legal Phases of Engineering. By Ivan C. Crawford. London: Macmillan and Co., Ltd., St. Martin's Street, W.C.2. Price 28s. 6d.

A Gas Turbine Driven Launch

WE were recently invited by the Rover Co. Ltd., to attend a demonstration of a 60ft launch, the "Torquil" now fitted with two Rover gas turbines, a small number of which have been ordered by the Admiralty to be adapted for special purposes. This unit is an oil-fired marine version of the road car turbine which the company demonstrated at the Silverstone race track this year.



GAS TURBINE LAUNCH "TORQUIL"

The Rover turbine works on an open circuit and employs a "free" power turbine. The maximum design rating is 200 h.p. but this output has been restricted for an initial period to 100 h.p. continuous running, with a maximum output of 150 h.p. This engine was the first gas turbine to be developed in this low-rated class and the nature of the problems involved in the scaling down of turbines from the more familiar 2000 h.p. class were discussed in a paper on road turbines in our issue dated July 2, 1948.

An illustration of the engine and a diagram of the working circuit are shown herewith.

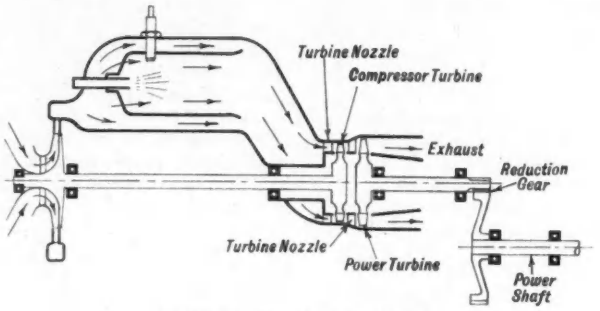


DIAGRAM OF POWER TURBINE

Air is ducted to the single-stage, single-sided centrifugal compressor, which has a maximum speed of 40,000 r.p.m. and a compression ratio

ROVER GAS TURBINE UNIT

WHEEL HOUSE

of 3·5:1 at 150 h.p. output. Oil is fed at 180 lb per sq. in. to the twin combustion chambers fitted to each turbine, through nozzles developed by Lucas, Ltd. The combustion process follows that commonly adopted in aeronautical practice whereby combustion is confined to a primary chamber around which flows a supply of secondary air which serves both to cool the chamber itself and to reduce the temperature of the products of combustion to 875 deg. Cent. The combined gas flow is then partially expanded first in nozzles and then in the compressor turbine itself which is mounted coaxially with the compressor. The gas is finally expanded in the power turbine which has a maximum speed of 35,000 r.p.m. and exhausts at a temperature 550 deg. Cent. through a diffuser situated at the entrance to the funnel. Both the turbine rotors are made of the new nickel alloy Nimonic 90 and the blades are forged and machined integrally with the disc. This method of production was dictated by the impracticability of adopting the normal fir-tree blade fixation method with this size of rotor. Precision casting methods are also being developed to produce the blade and disc integrally.

The drive from the power turbine is taken through a 7 : 1 reduction single stage spur gear, housed integrally with the turbine casing and the drive is further reduced in a reverse gear-box giving an overall reduction of 21 : 1 at the propeller shaft. The twin turbine sets are seated each on four rubber mountings on beds placed about 5ft apart on either side of a 50 h.p. diesel engine which has been retained to drive the central screw. The exhaust from each turbine is ducted separately to the funnels through the diffusers which helps to damp exhaust noises, and assists the forced ventilation of the engine-room. Insulated panelling has been used extensively in the engine-room to reduce further the very high noise level of a type associated with jet turbines.

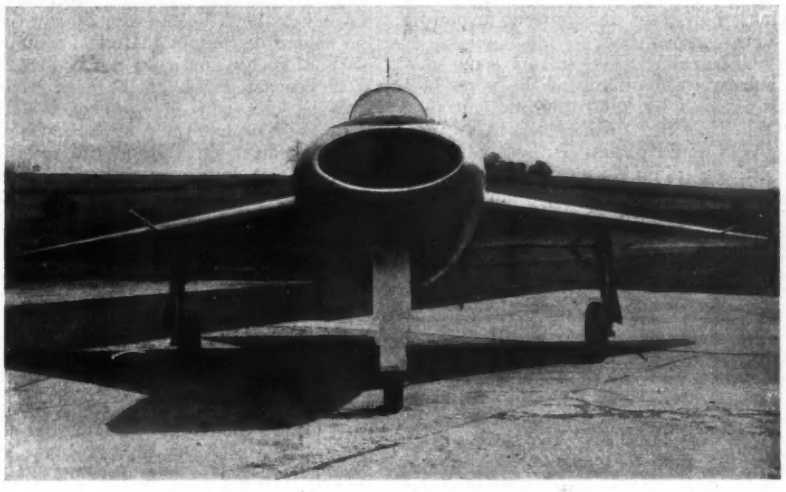
The absolute control of each turbine is effected by the use of a single throttle lever which determines the fuel flow to the combustion chambers, thereby fixing the speed of the compressor turbine and the power output independently of the power turbine speed. A second lever connected to the reverse box determines the direction of the screw. The use of a separate power turbine gives the engine exceptional flexibility: the nature of the torque-speed curve of the free turbine shows that the torque loading varies in a linear manner to engine speed and that the static torque is three times that available when developing full engine speed.

Starting is effected by the use of a normal car starter with a step up gear of 3 : 1 which is disengaged at a compressor speed of 10,000 r.p.m. under which conditions the compressor turbine is able to idle. Other auxiliaries driven from the compressor are the generator which is belt driven at 6000 r.p.m., a single geared oil pump and the fuel pump.

The engine measures approximately 2ft 6in by 2ft 6in by 4ft long and has an approximate power-weight ratio of 2.24 lb per horse power which compares with 2·68 lb and 2·98 lb per horse power attained by the Metropolitan-Vickers 2500 h.p. gas turbine and the Packard 1250 h.p. reciprocating engine respectively. The fuel consumption is stated to be 1.6 lb/b.h.p./hr when developing 100 h.p. and 1·251 lb/b.h.p./hr at 150 h.p., but it is anticipated that when fitted with a heat exchanger which the company is at present actually developing the fuel consumption will be reduced to 0·8 lb/b.h.p./hr. It was shown in the article to which we made earlier reference that there was an adverse cumulative effect on overall efficiencies when scaling down the component sizes and reducing the power output of gas turbines. This was in part due to the effect of blade profiles, blade tip and gland clearances being less satisfactory on the smaller turbine runners and also to the Reynolds number effect. There it was shown from dimensional similarity methods that a reduction in the linear dimensions of a gas turbine leads to a reduction in the Reynolds number associated with the flow and it follows that the relative gas frictional losses are considerably increased. In consideration of these losses incurred in smaller turbines the fuel consumption of 0·8 lb/b.h.p./hr as anticipated with the use of a heat exchanger can be regarded as encouraging at this stage.

A New Experimental Aircraft

THE Ministry of Supply has recently released dimensional details of another experimental aircraft specifically designed for high speed aerodynamic research. This machine, designated the P.111, was designed and made by Boulton Paul Aircraft, Ltd., and has just completed its first flight. The P.111 is similar in major respects to the Avro "delta" wing aircraft, the 107B which was discussed in our issue of September 8, 1950, having a similar triangular wing plan form with an aspect ratio of 1:1. The unorthodox design whereby pitching and lateral controls are effected by elevons fitted on the trailing edge of the wing, has introduced handling and stability problems both in the high speed and low speed range. To provide for contingencies attendant on the latter group a parachute device is housed alongside the rudder. This tail parachute is designed to assist spin recovery and, further, to act as an air break on landing, as a very high landing speed for this aeroplane is thought desirable at the present stage of development. Amongst the features which distinguish the P.111 from the Avro 107B are the low dorsal fin extension along the fuselage fairing into the pilot's canopy, the shorter nose, and the air intake of the Rolls-Royce "Nene" turbo jet engine which is placed in the nose. The span of the P.111 is 33ft 6in, length 26ft 1in, height over fin 12ft 6½in and wheel track 14ft 5in. No other information has been released by the Ministry of Supply.



BOULTON PAUL P111 EXPERIMENTAL AIRCRAFT

ALLDAYS AND ONIONS, LTD., TERCENTENARY.—This year the well-known Birmingham firm, Alldays and Onions, Ltd., celebrates its tercentenary. Although early records of the company were destroyed during the war, it has been established that a member of the Onions family founded the business in 1650. Some time later the business was amalgamated with William Allday and Sons and subsequently the efforts of the firm were directed to the development and production of plant for forges and foundries. During the past few decades a number of other businesses have been absorbed by the firm, including Thwaites Brothers, Peter Pilkington, Ltd., the Britannia Foundry Company, of Coventry, and the Roots Blower section of Samuelsons, Ltd. The products of the firm now include fans of nearly every type, furnaces for gas, oil and solid fuels, pneumatic and steam forging hammers, and a wide range of other equipment for forges and foundries.

Canadian Engineering News

(By our own Correspondent)

New Portable Compressor

A new light portable air compressor has been introduced by Canadian Ingersoll-Rand. It was designed in six months of work at the company's Sherbrooke plant. The design is functional, with tubular air receivers which form part of the frame. Delivered capacity is 125 cubic feet per minute at 100 lb. pressure. This figure was selected as the most suitable size for contractors, municipalities, public utilities and other users. The compressor is two-stage, with 45 lb. on the first stage. The power unit is a Canadian-made Chrysler industrial engine, rated at 40 h.p., the compressor taking 28 h.p. at a volumetric efficiency of 82 per cent. The compressed air demand works through a regulator known as the "UL-83," to control the speed of the engine, thus maintaining full line pressure. An outstanding property of the new model is its portability. Weight has been cut to a minimum by using a tubular frame and a plastic housing, cutting the total weight from 3600 lb to 2600 lb. The air compressor unit uses "Channel" type valves, dual-flow intercooling with directional fins on the compressor to reduce operating temperature and increase capacity. The starter and instrument panel are visible and can be used with the top half of the housing closed. The tow bar can be adjusted to the height of the towing vehicle and folded to reduce the overall length when stationary. With the tow bar extended the total length is 9½ft.

A Difficult Blasting Job

One of the trickiest blasting operations ever undertaken in Canada is being carried out across the rocky slopes of the Notre Dame mountains near Cowansville, in the Province of Quebec. Thousands of sticks of dynamite are cutting a new oil-line ditch, as American and Canadian crews lay 68 miles of 18in oil pipe from the international border at Highwater, Quebec, to Montreal East. Blasts involving up to 450 lb of dynamite each are excavating approximately 300 tons of rock and advancing a 6ft ditch about 200ft at a time. Dangers and difficulties are multiplied by the presence of an active 12in line, carrying crude oil under 840 lb pressure, which runs parallel to the present trench at a distance of only 6ft along its entire length. A new "split-second" blasting method is being used on the job. This technique reduces vibration, concussion and fly-rock by use of special electric blasting caps developed in the research laboratories of Canadian Industries, Ltd.

Infiltrated or Impregnated Alloys

By H. W. GREENWOOD

THE metallurgist has long been familiar with the idea of impregnating the pores of a sintered compact with lubricating oil to provide a self-lubricating bearing. In recent years impregnation has come to mean quite a number of other processes, such as the filling of the pores of a sintered or unsintered metal compact with a metal or alloy of lower melting point. It is also known to introduce particles of non-metallic substance in a metal powder matrix to produce such materials as diamond impregnated tools, cemented carbide tools, &c. The term infiltration is generally applied to the filling of pores of a sintered or unsintered compact with a metal or alloy of lower melting point by capillary action; usually by immersing the compact in a bath of liquid metal. To-day, the study and application of these techniques bids fair to be the most important development in powder metallurgy in our time.

It will be realised that there is some similarity between the filling of the pores of a metal compact by infiltrating molten metal and the sintering of a compact in the presence of a liquid phase. In both cases the infiltrating medium is a metal having a lower melting point than the metal comprising the major portion of the compact. It may be remembered that the first really important use of sintering in the presence of a liquid phase was in overcoming the brittleness and easy fracture of the early cemented carbide tools. Not until the value of the presence of a binder or cement was recognised was the practice of having a liquid phase present adopted as a constant factor. From that time onward a metal of the iron group, usually cobalt or nickel, has supplied the cement for almost all cemented carbides.

The physical properties of these products suggested that a somewhat similar technique would be of service in producing materials for the electrical industry capable of standing up to heavy duty as contacts. The ideal was a refractory material combined with a high conductivity metal and combinations of tungsten or molybdenum, both metals of high melting point, were made with copper or silver to supply the good conductivity. The use of powder metallurgy allowed of the production of porous compacts of tungsten or molybdenum and the filling of the pores or interstices with a connected and conducting medium such as copper or silver. There was also a demand for a heavy metal of reasonably high atomic weight for use in fabricating radium containers and for balancing parts. Tungsten again supplied what was required and was cemented by using a liquid phase during sintering containing copper and nickel. It is common knowledge that the earlier products of powder metallurgy were wanting in physical properties as compared with cast or wrought products. This was the direct result of the porosity of pressed and sintered bodies. Obviously material having anything up to 20 per cent porosity, or even more, could not be expected to have the strength or the ductility of solid metal. The use of infiltration or impregnation altered all this and the increase in strength and other properties by the use of these techniques is often dramatic. As an example one can quote a 0·3 per cent carbon steel powder pressed and sintered showing a tensile of 36,600 lb per square inch. When the compacts were infiltrated with 10–12 per cent copper the tensile strength rose to 102,000 lb per square inch and the Vickers hardness of 99 as sintered rose to 262 after infiltration.

The earliest experiments in infiltration had as their end the production of higher density, greater strength and hardness and, in the realm of compound metals for use in the electrical industry, the combining of high melting point and refractoriness with good electrical and heat conductivity. The attainment of these qualities with comparative ease opened up the way to many other achievements. These are, only now, being more fully exploited, and much of the work being done is still largely exploratory, but the value of actual achievement, still more the potentialities of the technique, are beyond doubt. We can already say that in the sphere of contact materials commercial production has been in force for years. With bearing metals of the type having a steel backing and the bearing surface of Babbitt type metal held by a copper nickel porous sponge sintered on the steel back there is also bulk production. The same applies to iron base bearings in which a porous iron compact is infiltrated with lead-base bearing alloys.

Some Possibilities

But by far the more interesting possibilities can be envisaged in the copper-infiltrated sintered steels produced specially for high strength and for corrosion resistant structural parts, also the copper infiltrated iron base diamond-metal and similar combinations for abrasive tools. A notable achievement of slightly different character during the late war was the proximity fuse in which sintered nickel and sintered iron were infiltrated by liquid mercury, not by heat or capillary action, for the pores were too small, but by centrifugal force. Finally, there is a class of materials having high strength coupled with resistance to oxidation at high temperature and comprising carbides and solid solutions infiltrated with high temperature resistant alloys. It can well be imagined that such a series of possibilities—to say nothing of the further likelihood, already realised in some directions, that precipitation reactions can be made use of to attain new and enhanced physical properties—will have resulted in the initiation of a host of special investigations, in these novel techniques.

Especially valuable work has been done in the United States of America, in Austria and in Germany and some excellent statements of possibilities and of governing conditions have been of interest. The conditions for the preparation of infiltrated alloys, which Austrian workers consider most favourable, as published last year by R. Kieffer and F. Benesovsky*, are:—

(1) The melting points of the two components in binary systems should be as far apart as possible. This is easily achieved in cases where tungsten and copper are involved, where the melting points of the metals are, respectively, 3370 deg. Cent. and 1083 deg. Cent., but does not appear to affect adversely the infiltration of iron with copper, melting points 1535 deg. Cent. and 1083 deg. Cent.

(2) The solubility of the components in one another at room temperature should be as small as possible. Where there is solubility the most favourable conditions are those in which the solubility decreases rapidly with temperature. It may be said that it is usual to add a small percentage of nickel or manganese to inhibit the solubility of iron in copper or vice versa, interfering with the process of infiltration.

(3) It is important to remember that the presence of eutectics, solid solutions or other intermediate phases can hinder the process of infiltration of the impregnating metal by increasing its volume, viscosity or both.

(4) The temperature at which infiltration takes place should be as near as practically possible to the melting point of the infiltrating metal to reduce any solution of the sintered metal in the infiltrant to a minimum.

(5) Time of infiltration should be as short as practicable, especially where systems have limited solubility in either the liquid or the solid state.

(6) Oxide skins in the metal to be impregnated must be avoided.

(7) Where metals are used whose oxides cannot be reduced in hydrogen, they must be introduced as master alloys (i.e., prealloyed).

(8) Infiltration in vacuo gives complete infiltration and is particularly advantageous when the infiltrating metal only wets the sintered metal poorly.

(9) Where the infiltrating metal alloys with the sintered metal the best procedure is to use as an infiltrant an alloy corresponding to the equilibrium composition at the temperature of infiltration.

(10) In systems of complete miscibility, in which one component boils at a low temperature, the infiltration must be carried out in closed vessels under pressure.

(11) Heat treatment with infiltration, either for homogenising or for improving physical properties must be carried out below the melting point of the liquid phase and if essential preferably under pressure.

Such a catalogue of conditions is surely an eloquent indication of the many possibilities not only of new combinations of metals, but also of the control of properties of the new products, which can mean so much in meeting particular specifications. One of the outstanding characteristics of metallurgy to-day is the exacting nature of the specifications that are almost a commonplace, whereas twenty years ago such specifications were not only unheard of but frankly impossible. It is possible to-day to consider binary systems of over a dozen types in which the infiltrating metal as well as that providing the sintered compact are commercial metals. Some of the commoner examples are comprised in the following table, taken in part from the paper just cited, by Kieffer and Benesovsky.

Infiltrating Metal	Sintered Porous Metal
Silver	*Molybdenum*, nickel, *tungsten*, cobalt, zirconium.
Aluminium	Chromium, molybdenum.
Bismuth ...	*Silver*, *copper*, cobalt, nickel.
Cobalt ...	Tungsten, *tungsten carbide*, chromium.
Copper ...	Cobalt, *chromium*, *iron*, *molybdenum*, *tungsten*, titanium-carbide, vanadium.
Iron	Tungsten carbide.
Mercury ...	*Nickel*, cobalt, iron, tantalum, tungsten.
Nickel... ...	*Tungsten*, *tungsten carbide*, molybdenum
Lead	Aluminium, cobalt, chromium, copper, *iron*, nickel, *tungsten*.
Tin	Cobalt, chromium, iron, nickel.
Thallium ...	*Aluminium*, copper, cobalt, iron, nickel, zinc.
Zinc	Molybdenum, tantalum, tungsten.

(The elements in italics are technically important for infiltration.)

It is also important to remember that

* Berg-U Huttenmannische Monatshefte. 1949. 94. 284–294.

alloys can be used as infiltrants in exactly the same way that single metals are used. Such types as brass or bronze can function, and there are many combinations offering particular advantages either from the point of view of strength or of resistance to corrosion or oxidation. A technique that has provided some most useful results, and holds out promise of application in many directions, consists in impregnating sintered compacts with alloys having the same constituents as the sintered compact, but in different proportions, so that they have a lower melting point. A British patent has been granted for this particular technique (B.P. 613041, 1944), in which highly porous compacts of a particular alloy are impregnated, as mentioned above, with an alloy of the same constituents of much lower melting point because the ratio of the component elements is quite different. In this particular case it is claimed that the process is economical as well as technically sound because (1) alloy scrap can be used; (2) lower compacting pressures are required because the porosity is not significant so far as the properties of the impregnated final product are concerned; (3) specially shaped parts of homogeneous structure can be made by suitable heat treatment after impregnation; (4) very large parts can be compacted in hydraulic presses; (5) wear on dies is low because of the low pressures required; (6) parts produced by this technique have higher density than parts made by the usual pressing, sintering and coining; (7) only the infiltrating alloy has to be melted, hence the amount of metal that has to be powdered is very much reduced. An example quoted in the patent referred to is that of parts made in a 64 : 36 brass made by pressing a 90 : 10 copper-zinc powder to 40 per cent density and impregnating at 905 deg. Cent. with 40 per cent of 40 : 60 brass and 20 per cent scrap Muntz metal, following the impregnation with homogenizing at 800 deg. Cent.

A totally different product is covered by another Patent (B.P. 608,124, 1944), in which the production of electric contact pieces or welding electrodes is carried out by reducing loosely compacted refractory oxide, such as tungsten oxide, to a highly porous metal which is then sintered and impregnated with copper or silver. It is claimed that up to 76 per cent of copper or 78 per cent silver can be absorbed by the sintered parts. Another application that has been found useful is the impregnating of a lighter with a much heavier metal, which can very notably increase the weight of the part. The impregnation of an iron skeleton with lead is an outstanding example. This is the reverse of the operation carried out in the production of heavy alloy of the G.E.C. type, where the sintered skeleton consists of tungsten filled with the much less heavy and lower melting copper and nickel, providing the liquid phase during sintering. Here there is no infiltration of a presintered skeleton, the whole of the ingredients being pressed together after intimate mixing and a liquid phase developing during sintering.

A very promising range of impregnated iron skeletons in which the impregnation was carried out with a copper-iron-manganese molten material has been described by Schwarzkopf (*Metal Progress*, 1950, January, page 64). In these cases the iron skeleton was pressed and sintered to 85 per cent density and then completely infiltrated with molten metal containing 90 per cent copper, 2 per cent iron and 8 per cent manganese. A most interesting table of results is provided from which one or two figures may be quoted. Simple infiltration with copper for one hour at 1160 deg. Cent. gave a yield strength of 61,200 lb per square inch and tensile of 67,500 lb per square inch. When infiltration was with copper 90 per cent, iron 2 per cent and manganese 8 per cent, the yield strength was increased to 89,500 lb per square inch and tensile to 91,500 lb per square inch. The effect of solution heat treatment and of precipitation hardening after solution heat treatment were also tried. The solution heat treatment consisted in heating to 710 deg. Cent. for half hour then to 870 deg. Cent. for a further half hour and then quenching with oil. For iron-copper alone this gave yield strength of 61,300 lb per square inch and tensile of 71,700 lb per square inch and for the iron-copper-manganese a yield strength of 70,500 lb per square inch and tensile 84,600 lb per square inch. The precipitation hardening of the solution treated specimens took the form of heating at 500 deg. Cent. for one hour and gave for the iron-copper material a yield strength of 75,400 lb per square inch, tensile 81,900 lb per square inch, while for the iron-copper-manganese the figures were: yield strength 87,100 lb per square inch, tensile 93,500 lb per square inch. Many other figures are quoted but these should suffice to indicate the use of infiltration in the provision of high strength materials which can fulfil many functions. The outstanding feature is the fact that here is the most economical method of producing a pore-free material by a powder metallurgy technique in which there exists a tremendous range of possibilities. At once one thinks of the technique producing a wide range of corrosion and oxidation resisting materials in which not only can bronzes and brasses play their part, but also the more resistant combinations such as stainless steel and similar alloys. There is also the important field of parts which will be resistant to very high temperatures and those which will give a good performance under load. It need hardly be mentioned that there are endless possibilities of influencing the final physical properties of materials produced by these techniques which obviously have by no means been exploited to the full. A simple example can be mentioned: that is the value and importance of maintaining the infiltrated compact at the infiltrating temperature for a definite period of time if optimum properties are to be attained. In many cases it will be found that infiltration is advantageously carried out in three stages. First sintering to obtain the porous skeleton, then infiltration at the requisite temperature and the correct composition of infiltrant and, lastly, what amounts to a further sintering in the presence of a liquid phase.

Where there is little or no material solubility between two metals it is sometimes advantageous to use metal powders coated with a second metal. This has proven particularly satisfactory in the case of iron powders coated with copper, nickel or copper-nickel. In many cases there is a direct advantage in using such powders in normal powder metallurgical practice, for it has been found that the tensile strength of compacts made from coated powders is about 50 per cent higher than when mixed powders are used. There is distinct advantage in using coated powders to produce pressings, which later are to be impregnated. Lower pressures give compacts that impregnate easily. The coating process consists in making use either of a solution of a salt of the metal to be coated or a volatile salt, which upon decomposition in suitable circumstances gives reduced metal. Electrolytic deposition has also been used and some of the processes have been covered by patents in the U.S.A. and in the U.K.

A general survey of the position such as is given in this paper provides one with what has the appearance of a vision of limitless possibilities, which, at the moment can only be exploited partially. It is obvious that there are tremendous fields awaiting investigation and that there is room for a wealth of research as yet unattempted. The outstanding feature of the more recent work on infiltration and impregnation is the promise it holds out of much more accurate control of properties than we have ever enjoyed before, and the parallel possibility of producing materials to specifications far beyond anything that can be attempted at the moment.

A Sea-going Hopper Dredger

SINCE February, 1950, the 8000 cubic yard hopper dredger "Essayons," has been deepening the approved 45ft by 2000ft Hudson River channel, dredging an average 25,000 cubic yards of mud and silt a day and depositing the material in deep water beyond Ambrose Lightship. This interesting vessel, which is claimed to be the world's largest sea-going hopper dredger, was built by the Sun Shipbuilding and Dry Dock Company for the Corps of Engineers of the U.S. Army, at a cost of approximately 10,000,000 dollars. The principal dimensions of the "Essayons" are:

Length overall	525ft 2in
Length between perpendiculars ...	500ft
Breadth moulded	72ft
Depth moulded...	40ft 5in
Draught loaded	27ft 8in
Displacement tonnage, loaded ...	22,120
Hopper capacity, cubic yards ...	8,000
Shaft horsepower	8,000

As a result of model tests it was determined that 8000 s.h.p. was necessary to attain suitable speeds and sufficient power for the pumps while dredging. This power is adequate for propulsion while dredging at a 3 m.p.h. rate against a 5 m.p.h. current. The estimated speed, fully loaded, in shoal water is 15·5 m.p.h. Model tests also indicated that marked savings in resistance could be realised by raising the drag pipe elbows clear of the water when proceeding to the disposal area, and, consequently, a sliding type of trunnion was adopted for the vessel. The drag, suction pipe, ball joint, trunnion elbow and the trunnion itself can all be placed on the main deck in order to facilitate docking and repair work. Use of a sliding trunnion also permits the positioning of the dredge pumps at the lowest possible elevation in the hull and ensures a level flow to the pumps. To improve manœuvrability, two double-plate rudders, in conjunction with twin screws, are provided. Watertight compartmentation is obtained by means of thirteen bulkheads, and the vessel is capable of floating with full hoppers and any two compartments flooded. All-metal, fireproof construction is provided throughout, and there is an automatic carbon-dioxide fire extinguishing system below deck. Steel lifeboats are stowed in mechanical gravity-type davits. Welded construction is employed throughout the vessel with the exception of a riveted gunwale angle at the strength deck and riveted bilge strake.

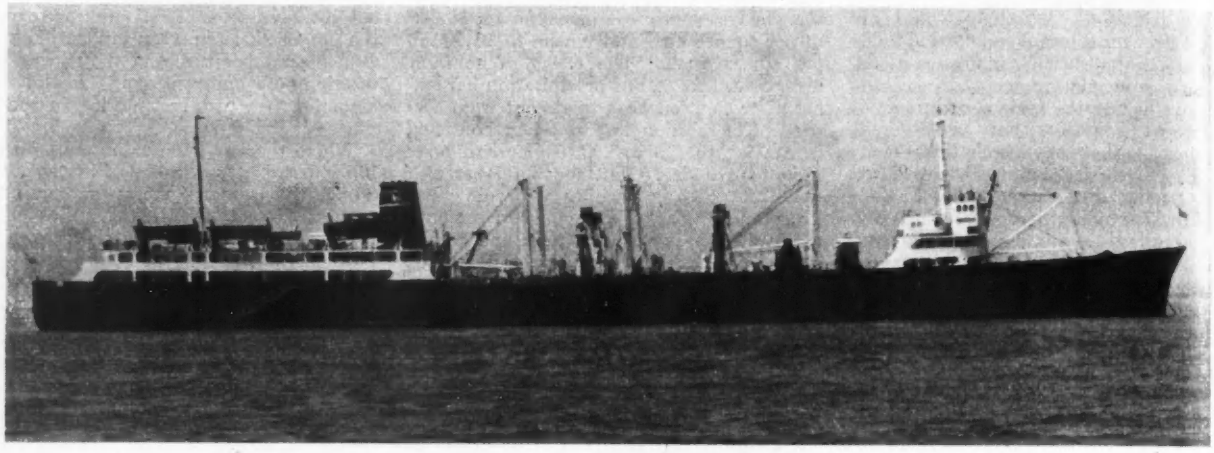
Machinery

The main power plant is turbo-electric and is equipped for automatic operation throughout. Steam is supplied by two Babcock and

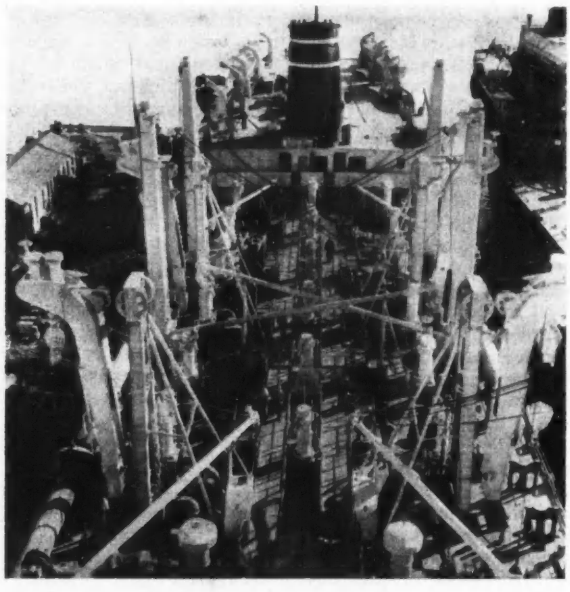
Wilcox sectional header marine water-tube boilers, oil fired, and designed for 600 lb per square inch working pressure at 850 deg. Fah. The boilers are equipped with superheaters, desuperheaters, tubular air heater, automatic superheat control, automatic feed-water control, automatic soot blowers, and automatic combustion control. Each boiler has a normal evaporation rating of 60,000 lb of steam per hour and an overload rating of 75,000 lb per hour, requiring approximately 2 tons of fuel oil per hour. Power for normal operation of the ship is provided by two geared main turbine-generator sets, each equipped with constant-speed governor, overspeed trip and a trip which automatically closes the steam supply in the event of a failure of the lubricating oil pressure. These turbines are standard Westinghouse marine units, operating normally at about 5400 r.p.m. Each turbine drives, through a single-reduction gear, three generators connected in tandem. The normal capacity of each turbine is sufficient to produce 4000 h.p. propulsion on each shaft and develop 600kW for auxiliary power. The propulsion motors are installed directly below the generators, and speed is obtained by variation of the propulsion generator voltage. Each motor is fitted with a tachometer generator which is wired to indicators located in the engine-room and in the pilot house. Up to full speed in either direction the propulsion speed can be controlled from the bridge or from the engine-room. After full speed has been reached, full power is maintained on each propeller by an automatic regulating unit.

The supply of boiler feed water requires two motor-driven, automatically controlled, variable-stroke pumps and one steam-driven reciprocating pump for standby service. There are three motor-driven centrifugal pumps which supply sea water for general service throughout the ship at 50 lb pressure. The main condenser circulating pumps are vertical centrifugal units arranged to supply cooling water to the respective condensers. The fire pumps, condensate pumps, fuel oil and transfer pumps, bilge pumps and lubricating pumps for normal operation are motor-driven units with steam standby units provided. Water for the flushing system and potable water system is supplied by conventional motor-driven pressure sets. Potable water and boiler feed water are produced by two submerged type high-pressure evaporators, each having a rated capacity of 30 tons of distillate from sea water per twenty-four hours with steam supplied at a pressure of 35 lb per square inch. One evaporator is arranged to distil potable and reserve boiler feed water and the other to distil make-up for the boiler feed system. The latter unit is also connected so that it can be used to produce potable and reserve boiler feed water. Another evaporator distils the contaminated drains and exhausts its steam to the fuel oil tank heating coils and fuel oil service heaters.

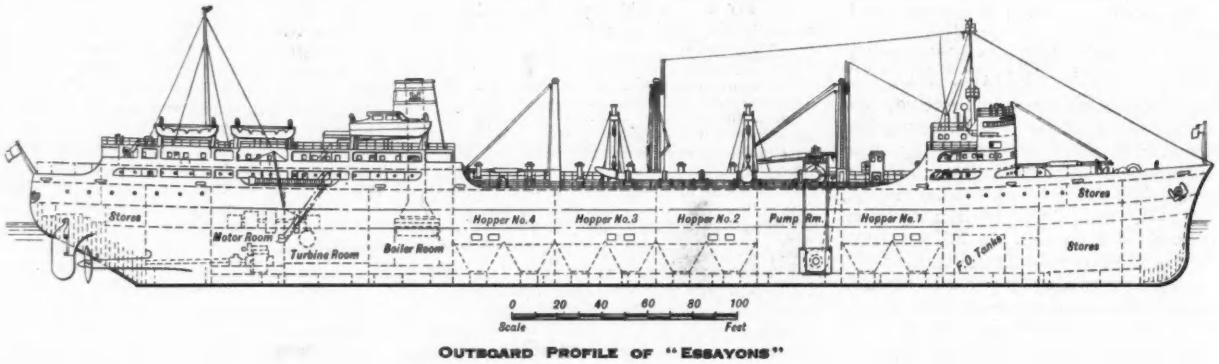
Dredging is performed by two pumps housed port and starboard in the pump room. These pumps are centrifugal side-suction dredge units, having 36in diameter suction and 32in diameter discharge ports. The casing and impeller are alloy cast steel, the head liners are alloy cast iron and the shoulder and throat



HOPPER DREDGER "ESSAYONS"



UPPER DECK LOOKING AFT

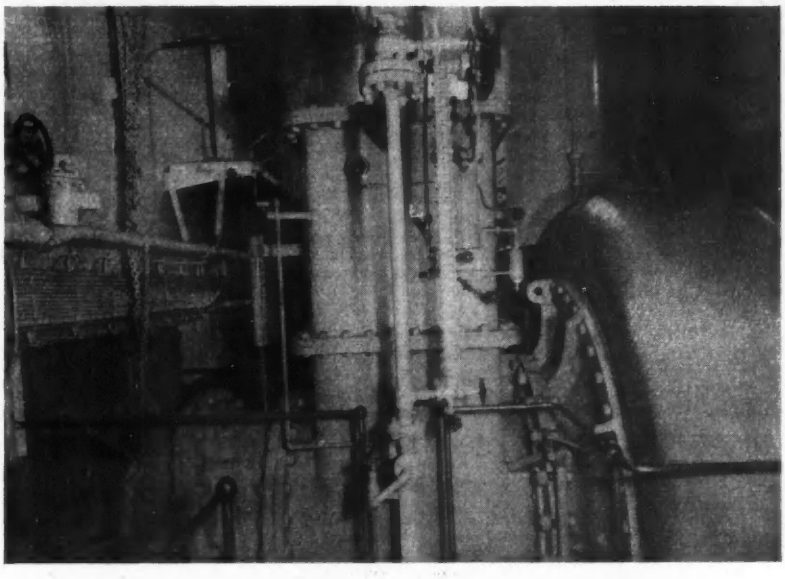


OUTBOARD PROFILE OF "ESSAYONS"

liners are moulded rubber with steel inserts. Each pump has a theoretical capacity of 63,450 U.S. gallons of water per minute at a speed of 180 r.p.m. The pumps discharge into a central distribution box located on the upper deck at the forward end of the pump room. The two 36in suction lines are suspended along the outside of the ship, one port and one starboard. A rubber-surfaced ball-and-socket type universal joint is installed in the pipe about 30ft from the trunnion to provide flexibility. The drag head, designed to maintain contact with the channel bottom and to act as an agitator and strainer for the material to be dredged, is installed on the lower end of the suction pipe. The suction pipe is supported at the ball joint and at the drag head by cables connected to motor-driven winches on deck. The depth to which the drag can be lowered is controlled by manipulation of the winches. Gauges are installed to indicate the dredging depth at all times. The suction head or drag can be lowered at an angle of about 45 deg., to a depth of 62ft, which is the maximum dredging depth. In this connection, it should be noted that the drag head may follow the channel bottom, be embedded several feet into the mud, or, at times, be above the material to be excavated. In order to remove water locked in the bins once the gates are closed after dumping has been completed, there is an unwatering system composed principally of a 7000 g.p.m. centrifugal pump driven by a 125 h.p. motor, situated in the dredge pump space, 10in suction pipe branches connected to each bin, and air-operated main and selection valves in all main, branch and backwash piping.

Since, in most areas, the dredging process releases gases, retained under pressure in the material at the river bottom, the dredge pump is likely to lose suction when gases enter it in greatly increased volume. Therefore, a Hoffman gas ejection system has been installed on the "Essayons." It consists of a Nash Hytor liquid piston vacuum pump whose suction end is connected to a gas accumulator in the dredge suction pipe-line at a point near the dredge pump, the suction pipe casting at this point being a separation chamber. The extraction point for the vacuum pump is at the top of this chamber, and the released gas is drawn off by the vacuum pump and discharged to the atmosphere through a back-fire trap. Automatic control is exercised over the Nash pump.

Each hopper bin has two openings in the bottom, each about 4ft 6in by 5ft. The openings are fitted with hinged rubber-sealed, watertight doors which are opened and closed by hydraulically operated pistons situated directly above and at upper deck level. Power for operation of each piston is provided by a hydraulic oil system arranged to maintain automatically 300 lb per square inch pressure in the system. The pumps, accumulators and sump tanks are in the pump room, with supply lines installed from the accumulator to the cylinders and return lines from the cylinders to the sump tanks. Each piston is provided with local control by a manually operated valve adjacent to the cylinder; however, in addition, each group of six cylinders for each hopper is arranged for remote and simultaneous operation through a pilot valve conveniently situated on the upper deck.

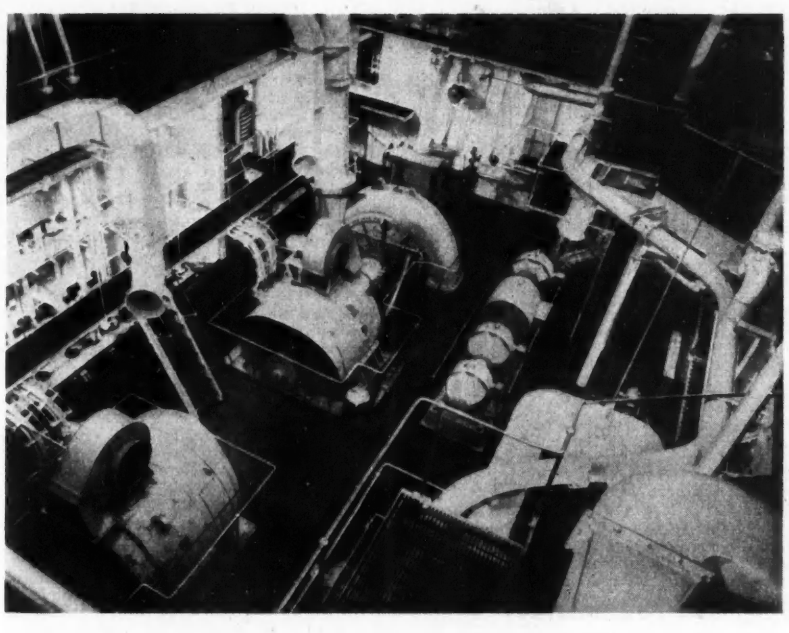


PORT SUCTION PIPE AND GAS ACCUMULATION CHAMBER

ELECTRICAL EQUIPMENT

The "Essayons" has three generators on the port side and three identical generators on the starboard side, each set mounted in tandem and geared to the main turbine on that side of the ship. All generators are direct current and each set contains a dredge pump, propulsion, and auxiliary generator. The propulsion generators deliver 3300kW each and are shunt wound for 600V to 720V. The dredge pump generators are each rated at 1600kW and are shunt wound for 600V. The auxiliary generators are each rated at 500kW and are three-wire machines shunt wound for 120V and 240V. The vessel has two diesel-driven generators for emergency use. Each generator has a capacity of 150kW and is three-wire, compound wound for 120V and 240V. There are two shunt-wound propulsion motors, one for each propeller, rated 4000 h.p. each at 92 to 110 r.p.m., and connected directly to the propeller shafts. Propulsion control is obtained by varying the fields of the propulsion generators from zero to full field, reversing the field excitation for astern operation. The propulsion motor fields are excited at a constant value. The propulsion motor and generator armature circuits are directly and permanently connected together. Excitation for the propulsion generators is obtained through separately driven rotary exciters. The propulsion control is so designed that up to, but not including, the last control point, the horsepower output is entirely in the hands of the operator on the bridge. However, when the control is set on the last point, the rotary exciter acts upon the generator fields in such a manner as to maintain a constant output of 4000 s.h.p. by each propeller within the limits of 92 to 110 r.p.m. The two dredge pump motors are each rated at 1850 h.p. on application of 500V at a speed of 155 to 180 r.p.m. The dredge pump motors are shunt wound and separately excited; speed control is obtained by a combination of the variable-voltage and field-regulation methods.

The "Essayons" was designed by the Marine Division of the U.S.A. Corps of Engineers, under the direction of Colonel F. F. Frech, District Engineer, Philadelphia District, and is operating in New York Harbour under the supervision of Mr. Henry G. A. Hayward, Chief of Plant Branch, Rivers and Harbours Division, New York District, Corps of Engineers, U.S. Army, 80, Lafayette Street, New York City.



PUMP ROOM OF "ESSAYONS"

THE EMPLOYMENT RETURNS—Figures issued by the Ministry of Labour on the employment situation at the end of August state that the estimated increase in the working population that month was 72,000. Of a total working population of 23,406,000 the number in civil employment was 22,418,000, and 284,000 were unemployed; the remainder were in the Forces. In the metals, engineering and vehicle industries the number of persons employed increased by 21,000 during the month.

British Patent Specifications

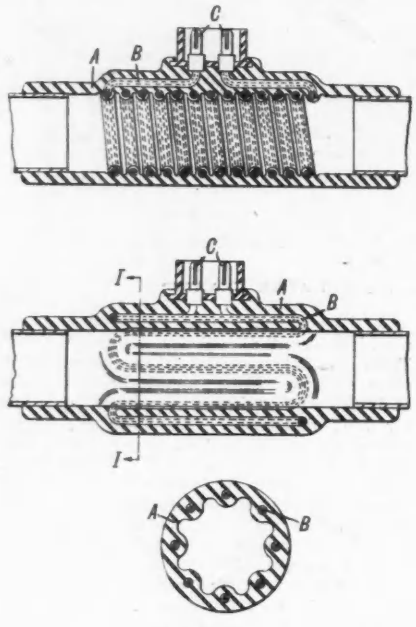
When an invention is communicated from abroad the name and address of the communicator are printed in italics. When an abridgment is not illustrated the specification is without drawings. The date first given is the date of application; the second date, at the end of the abridgment, is the date of publication of the complete specification.

Copies of specifications may be obtained at the Patent Office, Sales Branch, 25, Southampton Buildings, Chancery Lane, W.C.2, 2s. each.

INTERNAL COMBUSTION ENGINES

640,679. December 15, 1947.—Improvements in and relating to the Cooling Systems of Internal Combustion Engines, Harold John Greenland, of Rowan Cottage, Aldenham Avenue, Radlett, Hertfordshire.

The invention consists of an electric heater in some part of the cooling circuit whereby the coolant may be heated to any desired degree at such times as the engine is out of operation. The plain water hose which normally connects the radiator to the engine or water pump is replaced by a moulded rubber or like hose *A* in the wall

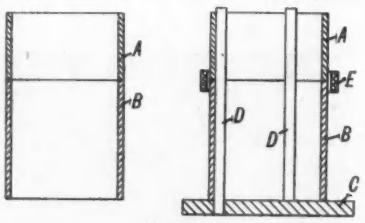


No. 640,679

of which is moulded an electric resistance wire *B*, preferably of the type enclosed in a thin, flexible plastic covering. The wire may be arranged helically round the water space within the hose, as shown in the top view, or it may be serpentined backwards and forwards axially of the hose, as shown in the lower views. The ends of the wire are taken to the terminals *C* of a plug or socket, which is also moulded in a thickened portion of the wall of the hose and which forms a terminal to which the mains or other current supply may be connected at such times as it is required to heat the cooling medium when the engine is not in use. That part of the wall of the hose between the heating wire and the inner surface is, preferably, thinner than that between the heating wire and the outer surface. For convenience, the inner wall is helically or longitudinally fluted, ridged or similarly formed, so as to increase the heated area, which is in contact with the fluid medium.—*July* 26, 1950.

640,845. August 18, 1948.—Improvements relating to Cylinder Liners, The British Piston Ring Company, Ltd., of Holbrook Lane, Coventry, and Thomas Ralph Twigger, of the company's address.

The invention consists of a two-part liner adapted to be inserted in a cylinder bore and having the contiguous ends of the parts united by brazing, welding, or the like. The drawings include sectional side elevations illustrating a liner constructed in accordance with the invention. The part *A* of the liner required to have greater resistance to wear than the other part *B*, is made from an iron alloy containing about 1·5 to 2 per cent of carbon and 28 to 34 per cent of chromium. The other part *B* is made from any iron of the kind usually employed in cylinder liners. The two parts are made as thin as is convenient and may be formed by centrifugal casting. Also they are made of any appropriate relative lengths. The contiguous ends may be flat. Alternatively, they may be adapted to inter-engage in various ways—for example, in the manner of a spigot-and-socket joint. The ends may be butt welded by electrical or other heating. But preferably they are united by a brazing material having a high melting point,



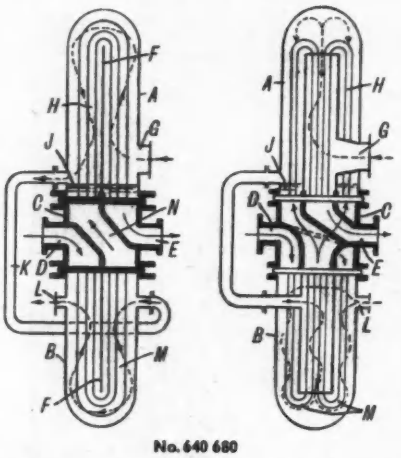
No. 640,845

such as silver solder. When uniting the parts they are held in a suitable jig to ensure accurate alignment. A convenient jig is shown in the drawing. It comprises a base *C* from which extend three or more rods *D* arranged so that the inner surface of the liner parts can lie in contact with them. Also the jig may include an electrically-heated coil *E* around the junction of the liner parts *A* and *B* and adapted to fuse the brazing material. After the parts *A* and *B* have been united the inside and outside surfaces may be treated by a grinding or other machining operation.—*July* 26, 1950.

HEAT EXCHANGERS

640,680. December 17, 1947.—Improvements in Heat Exchange Apparatus for Fluids, The British Thomson-Houston Company, Ltd., of Crown House, Aldwych, London, W.C.2.

In heat exchangers wherein a condensible fluid is arranged to impart heat to another fluid, it is advantageous to draw off the maximum of heat from the condensate itself. In the left-hand drawing there is shown in vertical section a heat exchanger *A*, in which theh eating steam is condensed, and an exchanger *B* in which the heat contained in the condensate is absorbed as far as possible, the exchangers *A* and *B* being connected vertically one above and the other below, a mutual distribution chest or water box *C*, comprising the inlet pipe connection *D* for the water to be heated, and its outlet pipe connection *E*; this chest, moreover, carries lateral flanges intended for mounting the apparatus upon its foundations. The exchangers may take various forms, for example, the U-shaped pipe system shown with a central baffle or partition *F*, which causes the steam on entry to flow outwardly from the chest along one limb of the tubes and then inwardly towards the chest along the other limb of the tubes. After the heating steam is admitted through the pipe *G* it is circulated about the pipe system *H*, through which the water flows, as shown by the arrows and dotted lines, and is thereby condensed, the condensate being collected at *J* at the bottom of the exchanger *A*. From there the condensate flows by gravity through the piping *K*, into the exchanger *B*, where it circulates about the pipe system *M*



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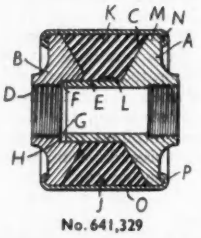
which extracts further heat from it, the circulation being first outwards from the chest *C* and then inwards towards it before its evacuation through the piping *L*. In this system *M* is circulated the feed water on admission through the piping *D*, where it is first brought in heat exchange relation to the condensate, the heated water leaving the exchanger *B* through the passage *N* in the distribution chest *C* so as to enter the upper pipe system *H*. There the already heated water is in heat exchange relation with the live steam and it leaves, heated, through the pipe connection shown on the right. The example shown on the right relates to exchangers of the double circulation type, the same reference letters designating the analogous parts. Such exchangers can be grouped together, the pipelines of their water boxes being directly assembled flange to flange, the use of connecting pipelines being dispensed with, so that difficulties due to the effects of differences of expansion to which such pipelines give rise in normal arrangements are obviated.—*July* 26, 1950.

TUBE AND PIPE COUPLINGS

641,329. June 19, 1948.—Pipe Couplings, The Dunlop Rubber Company, Ltd., of 1, Albany Street, London, N.W.1; and Alfred Faulkner, of the company's works at Fort Dunlop, Erdington, Birmingham, 24.

This invention relates to pipe couplings and more particularly to couplings permitting limited relative rotation of the coupled pipes. As shown in the accompanying drawing, the coupling comprises two rigid members *A* and *B* in the form of flanged annular brass castings with a convex frusto-conical face *C* on one side of each rigid member and with the bore *D* of each rigid member adjacent to the other face threaded to permit a pipe or elbow to be screwed to it. The member *A* has an axially-extending sleeve *E* of the same internal diameter as the bore of the member, which sleeve projects from the conical face *C*. The unthreaded part *F* of the bore of the member *B* is enlarged to receive the end portion only of the sleeve *E*, the outside diameter of the latter being such that it is a sliding fit in the member *B* and is thus in rotatable engagement



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therewith. The length of the sleeve is such that there is a gap *G* between the end of the sleeve and the shoulder *H* formed in the bore of the member *B*. The convex frusto-conical faces of the flanges thus oppose one another and an annular gap *J* is left between them, the axially-extending section of which is trapezoidal. This annular gap is occupied by a rubber annulus *K* bonded to the frusto-conical faces of the flanges, but not to the outside *L* of the sleeve, so that relative movement of the rubber annulus thereto is possible. The rubber annulus thus forms a seal between the two flanged members. The flange *M* of each member has a raised rim *N* on the face adjacent the threaded end of the bore and surrounding the rubber annulus is a metal cover *O* with inwardly curved edges *P* which engage the raised rims and thereby retain the cover in position.—*August* 9, 1950.

METALLURGY

640,448. August 28, 1945.—Improvements in and relating to the Manufacture of Steel, Jean Charles Fourmanoit, of 57, Avenue Jupiter, Brussels, Belgium.

This invention consists in the use, as a carburising product in the manufacture of steel, of a product obtained by impregnation of calcined limestone with a carburising substance. As an example of carrying the invention into effect, 1000kg of rock limestone are calcined in such a manner as to obtain a homogeneous product. As soon after the calcination as possible the product is subjected inside an autoclave to a vacuum of about 70cm of mercury for one hour in such a manner as to extract all the occluded gases; 2000kg of pitch heated to a temperature of about 250 deg. Cent. is afterwards injected into the autoclave in which the vacuum has been made. A pressure of 8kg per square centimetre is established for about two hours, by maintaining the temperature of 250 deg. Cent. or a temperature near the latter. The excess of pitch is allowed to flow off. A product is obtained inside the autoclave, which is used in the manufacture of steel for the introduction of the non-combined carbon corresponding to the graphitic or combined carbon of the cast iron. The product used according to the invention may also be obtained by an impregnation by means of a prolonged heating of pieces of calcined limestone in the carburising substance in an open vessel. As an example of treatment of a particular steel the following may be given:—To a charge consisting of 10·3 tons of scrap steel and 37·7 tons of scrap blooms were added 2·8 tons of carburising limestone according to the invention. The analysis of the steel thus obtained was:—C, 0·060; Si, 0·009; Mn, 0·375; P, 0·008; S, 0·009.—*July* 19, 1950.